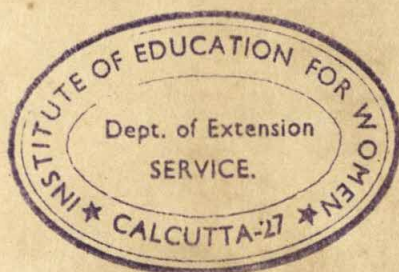




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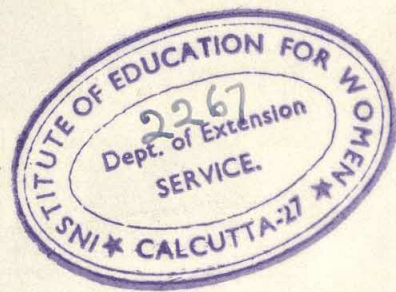
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Volume 7



IN NINETEEN VOLUMES AND
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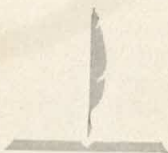


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Gg

is the seventh letter of our alphabet. Historians believe that it came from an Egyptian

hieroglyphic, or picture symbol, for a boomerang-shaped throwing stick. The Greeks made it the third letter of their alphabet, and used it for the sound of our *g*. The Romans borrowed the letter from the Greeks, and used it for both *g* and *k* sounds. Later, they added a vertical stroke to it, and used the new form for the sound of *g*, and the older form for the *k* sound. See ALPHABET.

Uses. *G* or *g* is about the 16th most frequently used letter in books, newspapers, and other printed material in English. On a school report card, *G* means *good*; in physics, it indicates *gravity*; in dictionaries and reference works, it stands for *German*. In geographic abbreviations, *G* may stand for *gulf*. In measuring weight, *g* stands for *gram*; in electricity, it indicates *conductance*. In English money, *g* means *guinea*, equal to one pound and one shilling.

Pronunciation. In English, a person pronounces hard *g*, as in *gun*, with his tongue back, its sides touching his velum, or soft palate, and with his vocal cords vibrating. *G* can also have the sound of *j*, as in *ginger*. In some English words derived from the French, such as *garage* and *rouge*, *g* has a *zh* sound. When followed by *h*, in such words as *high* or *bought*, *g* is silent. In other words, *gh* may have the sound of *f*, as in *rough* and *cough*. See PRONUNCIATION.

I. J. GELB and J. M. WELLS



The seventh letter came from the same form as the third letter, *C*. The Romans used it for two sounds, *G* and *K*. Later, they added a vertical stroke to show the *g* sound we know today. They kept the old form for the *k* sound.

G

The Romans, about A.D. 114, gave the letter its final *G* form.

Г

The Greeks, about 600 B.C., wrote the letter as a right angle. They made it their third letter and called it *gamma*.

7

The Phoenicians, about 1000 B.C., wrote *C* like a hook.

7

The Egyptians, about 3000 B.C., wrote with a picture symbol that represented a boomerang.



The Small Letter *g* first appeared in the A.D. 300's. Monks shaped this letter in the 800's. By about 1500, it had the form that we know today.

C g

A.D. 300 A.D. 800

TODAY
g g

G

G is a symbol used in aviation for one *gravity*, the force needed to overcome the pull of the earth's gravity. It is written as a capital letter—G. The earth's pull increases the speed of a falling body 32.16 feet per second each second that it falls. This increase is called the *acceleration of gravity*, and its symbol is a small italic *g*. When airplanes are making power dives, their acceleration becomes even greater than the acceleration of gravity. The force needed to pull them out of a dive is measured in numbers of G's. A force that slows up speed is said to produce *negative acceleration*. A pilot cannot stand a force much greater than 9 G's. Strong negative acceleration causes a centrifugal force on the body and brings unconsciousness. At 3 or 4 G's in certain spins the pilot experiences a "red-out." His face becomes flushed, and he sees red before his eyes. At 5 G's or over he experiences a "blackout," in which he sees black and loses consciousness. See also BLACKING OUT; RED-OUT; STAPP.

E. A. FESSENDEN

G-MEN. See FEDERAL BUREAU OF INVESTIGATION.

GABARDINE, *GAB* or *DEEN*, is a fabric woven in such a way that it has diagonal lines of the yarn raised on one side of the cloth. This is called a *twill* weave. Gabardine may be made of worsted wool, mercerized cotton, or spun rayon. It usually comes in widths of 36 inches in cotton and spun rayon, and 54 inches in wool. Manufacturers often use cotton and rayon gabardines for curtains, shirts, dresses, slacks, and uniforms. Wool gabardine is frequently used for uniforms, raincoats, and suits. The name gabardine also applies to raincoats made of wool gabardine. People in the Middle Ages first used the word *gabardine* for a type of cloak. GRACE G. DENNY

GABBRO. See Rock (Intrusive Rocks).

GABLE is the triangular shape formed where the sloping roofs of a building with a pitched roof meet the end walls. At the end of such a building, the gable forms a triangle between the eaves and the ridge, or peak, of the roof. Buildings with flat roofs or roofs that slope up from all four sides have no gables at all.

In old European cities such as Rouen, Bruges, Antwerp, Louvain, and Nuremberg, travelers have long admired the steep-roofed houses and public buildings with their many gables. In gables of The Netherlands, Bel-

The Three Gables on the front of this house have timbering that emphasizes their triangular shape. The end wall also has a gable, and the two dormer windows are set into their own gables.

Chicago Architectural Photographing



gium, and Germany, square indentations called *corbie steps* were frequently cut into the sides of projecting gable walls. Such gables are referred to as *crow-stepped* or *stepped gables*. Early American architecture used many gables. The use of the gable in American colonial times, and later, is reflected in Nathaniel Hawthorne's famous tale, *The House of the Seven Gables*. The use of gables has decreased during the 1900's, because of the popularity of flat roofs. The gables used on buildings today are usually as simple as possible.

SIBYL MOHOLY-NAGY

GABLE, CLARK (1901-1960), was one of the world's best-known motion-picture personalities. Born William Clark Gable at Cadiz, Ohio, he went to work in a rubber factory at 15. He joined an acting company in Kansas City at 19. His first Broadway success was in *What Price Glory?* (1924). This led to his motion-picture debut in *The Painted Desert* (1930). His most famous roles were in *Mutiny on the Bounty*, *Gone With the Wind*, and *It Happened One Night*. Gable served in the U.S. Army Air Force in World War II. HARRIET VAN HORNE

GABON, *gah BOHNG*, is one of the four republics of French Equatorial Africa. It lies on the west coast of Africa, between Spanish Guinea and Cameroun on the north and the Republic of the Congo on the south. For location, see FRENCH EQUATORIAL AFRICA (map). Libreville is the capital of Gabon (see LIBREVILLE).

GABRIEL was one of the archangels. He was the messenger of God to man. Gabriel is mentioned in the Old Testament in connection with revelations to Daniel

The Archangel Gabriel appears often in paintings, as in this one by the Flemish artists Jan and Hubert van Eyck.

Culver



(Dan. 8:16; 9:21). He is also mentioned at the announcements of the birth of John the Baptist and of Jesus in the New Testament (Luke 1:19, 26). His feast day in the Roman Catholic Church is March 24. See also AN-
NUNCIATION; ARCHANGEL.

GLEASON L. ARCHER, JR.

GABRILOWITSCH, OSSIP. See TWAIN, MARK (His Travels).

GAD was the name of the seventh son of Jacob, the child of his wife's maidservant, Zilpah (Gen. 30:9-11). The tribe of Gad claimed descent from him. This tribe settled in the highlands east of the River Jordan, in an area known as Gilead. To the east lived the Ammonites, with whom Israel was frequently at war. The judge, Jephthah, and the prophet, Elijah, were from Gilead. See also GILEAD.

JOHN BRIGHT

GADFLY. See HORSEFLY.

GADOLINIUM, *GAD oh LIHN ih um* (chemical symbol, Gd), is one of the rare-earth metals. Its atomic number is 64, and its atomic weight is 157.26. It was discovered in 1880 by the Swiss scientist Jean de Marignac, who named it in honor of the Finnish chemist Johann Gadolin. Gadolinium is found in gadolinite with other rare earths, and is best separated from them by ion-exchange processes. The silver-white metal melts at about 2,460°F., and boils at about 5,430°F. It is available commercially. Gadolinium is used in control rods in nuclear reactors. See also ELEMENT, CHEMICAL; RARE EARTH.

FRANK H. SPEEDING

GADSDEN, Ala. (pop. 58,088; alt. 555 ft.), is an important industrial center in Alabama. It lies on the banks of the Coosa River, about 65 miles northeast of Birmingham. For location, see ALABAMA (color map).

The city's industries manufacture steel, textiles, nails, wire, bolts, soil pipe, tractors, cotton pickers, mowers, stoves, furnaces, furniture, lumber, boats and boating equipment, and rubber tires and tubes. Dairy and beef cattle and poultry products also come from Gadsden.

Gadsden, founded in 1840 as a farm village, was incorporated in 1871. It was named for James Gadsden, who negotiated the Gadsden Purchase. The city has a commission form of government, and is the county seat of Etowah County.

CHARLES G. SUMMERSELL

GADSDEN, CHRISTOPHER. See SOUTH CAROLINA (Famous South Carolinians).

GADSDEN, JAMES (1788-1858), was an American statesman. While he was minister to Mexico from 1853 to 1856, he arranged for the United States to buy the strip of land known as the Gadsden Purchase. This land was needed for the route of a transcontinental railroad which he had planned as president of a railroad company. Gadsden was born in Charleston, S.C. See also GADSDEN PURCHASE.

RICHARD N. CURRENT

GADSDEN FLAG. See FLAG (color picture, Flags in American History).

GADSDEN PURCHASE. The treaty that ended the Mexican War in 1848 left some doubt about the western part of the boundary between Mexico and the United States. To clear up this question, and also to provide the United States with a good southern railroad route to the Pacific Coast, the government bought from Mexico a strip of land that included the region south of the Gila River in what is now Arizona and New Mexico. James Gadsden, a railroad promoter serving as United States Minister to Mexico, conducted the negotiations with Antonio López de Santa Anna, the



The Gadsden Purchase was so called because James Gadsden arranged the treaty with the president of the Mexican Republic.

Mexican president. The treaty of sale was signed on Dec. 30, 1853, and the two countries exchanged ratifications of the treaty on June 30, 1854.

The land included in the Gadsden Purchase covered 45,535 square miles. The United States bought it for \$10,000,000. The sale met opposition in Mexico and was one of the reasons for Santa Anna's banishment in 1855.

NORMAN A. GRAEBNER

GADWALL is a rare river duck of the Northern Hemisphere and Africa. This grayish-brown duck is about 20 inches long, and weighs around 2 pounds. It is the only American river duck with a white spot on part of its wing. Gadwalls build their nests in marshes,

The Male Gadwall Duck loses its showy feathers during the summer months and grows plumage that resembles the dull-colored female. The duck cannot fly well during this period when it grows new feathers. The dull color serves to protect it.

CRUECKSHANK, NAS



meadows, and small islands. They lay 7 to 12 creamy white eggs. The gadwall sometimes dives for many kinds of water animals. It also eats grains. Its flesh usually is tasty, depending on what the bird has eaten.

Scientific Classification. The gadwall belongs to the family Anatidae. It is classified as genus *Anas*, species *strepera*.

JOSEPH J. HICKEY

See also DUCK.

GAEA. See TERRA.

GAEL, *gayl*, is a name given to the Goidelic (Gadhelic) branch of the Celtic-speaking peoples. The Goidels came from the European continent and settled in Ireland. From there, some went to the Isle of Man.

The name *Scotti* was used for Irishmen in Latin documents. In the A.D. 400's, some of these Irish Scotti settled in Scotland and gave the country their name. The Gaels became the ancestors of the Scottish Highlanders. Today the term *Gaels* often means the Highland Scots, but if language alone is considered, the Irish have an equal right to the name.

WILLIAM F. McDONALD

GAELIC LANGUAGE

GAELIC LANGUAGE belongs to the Celtic branch of the Indo-European family of languages. The Gaels introduced it to Ireland, from Europe, and later to the Isle of Man (see **GAEL**). Irish invaders took it to Scotland about A.D. 500. Around 1300, this *Common Gaelic* language divided into two branches, Irish Gaelic and Scottish Gaelic. *Manx*, the Gaelic spoken on the Isle of Man, is now almost extinct. Spoken Irish began to split into dialects soon after 1200. The three main dialects are now those of Munster, Connacht, and County Donegal in Ulster.

Invaders from England tried to impose the English language upon the Irish and Scots, beginning in the 1100's and 1200's. They were not successful at first. By 1800, Gaelic speakers were in the minority in Scotland. By 1851, only about one fourth of the population of Ireland spoke Gaelic. It declined even after 1893, when Douglas Hyde, Eoin MacNeill, and others founded the Gaelic League to revive it.

After Ireland became an independent dominion in 1922, Irish became its official language. About one person in five in Ireland can speak Irish today, but only one in 20 uses it daily. About 95,000 persons in Scotland speak the Gaelic language.

VIVIAN MERCIER

See also **IRELAND** (Language).

GAELIC LITERATURE includes all writings in the Gaelic language. But often the term is used only for the Gaelic literature of Scotland. For the Gaelic literature of Ireland, see **IRISH LITERATURE**.

The spoken Gaelic of Scotland diverged from Irish Gaelic about 1300. The written language, Common Gaelic, remained in use in both Ireland and Scotland until much later. *The Book of the Dean of Lismore* is the first important manuscript to show unmistakable Scottish Gaelic. It was written about 1520, and includes Scottish and Irish ballads and Common Gaelic bardic poetry. The first Scottish Gaelic book, a translation of John Knox's *Liturgy*, was published in 1567.

Scottish Gaelic is rich in poetry, but poor in prose. Mary Macleod and John Macdonald (Iain Lom) were the chief poets of the 1600's. Alexander Macdonald and Duncan Ban Macintyre outshone them in the 1700's. Interest in ancient literature increased after the 1760's, when James Macpherson published alleged translations from the legendary poet Ossian. The poems of Sorley Maclean and George Campbell Hay began a small revival in the 1940's.

VIVIAN MERCIER

GAFF-TOPSAIL CATFISH. See **FISH** (Reproduction; picture, Unusual Breeding Habits).

GÁG, galg, WANDA (1893-1946), an American artist, wrote and illustrated children's books. Many consider her the first true American storytelling artist. Probably her best-known book is *Millions of Cats* (1928), which is widely regarded as a classic. It greatly influenced later illustrators. Her work is included in permanent museum collections in America and Europe.

Wanda Gág began writing and illustrating stories for children when she herself was a child. Her quaint peasant characters show the influence of European folk traditions, which surrounded her at her home town, New Ulm, Minn. People there had come to America from Austria, Bohemia, and Germany. She studied art at St. Paul, the Minneapolis School of Art, and the

Art Students League in New York City. *Growing Pains* (1940), tells the story of her life.

Her books include *Funny Thing* (1929), *Gone Is Gone* (1935), and *Nothing at All* (1941). She illustrated and gave new meaning and flavor to *Tales from Grimm* and *Snow White and the Seven Dwarfs*. She also translated them from German.

GEORGE E. BUTLER

GAG RESOLUTIONS. See **ADAMS, JOHN QUINCY**.

GAGARIN, gah gah rin, YURI ALEKSEYEVICH (1934-), a Russian air force major, became the first human to travel in space. The Soviet *cosmonaut*, or spaceman, circled the earth on April 12, 1961, at a speed of more than 17,000 mph. From blastoff to landing, his trip lasted 1 hour and 48 minutes. His space



Cover for *Time*, the weekly news magazine, by Boris Chaliapin. Reproduced by permission.

The First Man in Space, Yuri Gagarin, wore a space suit equipped with instruments that recorded his body reactions.

ship *Vostok* was in orbit for 89.1 minutes. At the highest point, Gagarin was about 188 miles above the earth.

Gagarin said he suffered no ill effects from the flight. "I withstand well the state of weightlessness," he radioed from his space capsule.

Gagarin was born on a farm near Gzhatsk, west of Moscow. He attended vocational and technical schools, and was graduated from the Orenburg Air School.

See also **SPACE TRAVEL** (Man in Space).

GAGE, THOMAS (1721-1787), a British general, gave the orders that resulted in the first battle of the Revolutionary War in America. In 1774, he was appointed governor and commander in chief of the province of Massachusetts. Although he and his American wife were personally popular, he found the people increasingly defiant. In April, 1775, he heard that they were collecting military supplies at Concord, and he ordered a detachment of troops to seize the supplies. His soldiers were fired on at Lexington and Concord, and suffered heavy losses. Two months later, Gage ordered the attack on Breed's Hill in the Battle of Bunker Hill, but it was so costly that it led to his recall.

Gage was born at Firle, Sussex. He entered the army



Chicago Historical Society

General Gage Receives the Children of Boston. While this English general was occupying Boston, his troops liked to tease the Boston children by interfering with their games. At last a group of the children called on the general to complain. He then ordered his men to stop annoying them.

in 1741, and came to America with General Edward Braddock in 1755. He was with Braddock's troops at Fort Duquesne, when Indians in hiding shot them down. In 1760, he became governor of Montreal, and from 1763 to 1772, was British commander in chief in North America.

WILLIAM B. WILLCOX

GAILLARD CUT. See PANAMA CANAL.

GAILLARDIA, *gay LAHR dih uh*, is a flower that looks like a large daisy with a purple disk and yellow or red rays. It is also called *blanket flower* and *fire-wheel*. Most gaillardias are native to the central and western United States, but gardeners often raise them in other places.

The head really consists of two different kinds of

Gaillardias Are Large, Showy Flowers which grow on long stems. Double flowers are considered especially beautiful.

J. Horace McFarland



flowers, the tubular flowers in the disk, and ray flowers with long petals. The plant may be an annual, a biennial, or a perennial. Some types grow 2 or 3 feet high. They grow from cuttings or from seeds, depending on the type, and thrive in sunny, open places.

Gaillardias produce many flowers from June to frost in autumn. *Gaillardia aristata* has a head that sometimes measures 4 inches across, with yellow petals. The yellow rays of *Gaillardia pulchella* have bases of rose-purple. Other types have canary yellow petals, and bright crimson or rich maroon disks.

Scientific Classification. Gaillardia belongs to the family *Compositae*. A common type is genus *Gaillardia*, species *pulchella*.
DONALD WYMAN

GAINES, GEORGE STROTHER. See ALABAMA (Famous Alabamians).

GAINSBOROUGH, GAYNZ buh ruh, THOMAS (1727-1788), was one of the greatest British painters. He was primarily a portrait painter. His only competitor in England in this field was Sir Joshua Reynolds, who was an intense rival. Gainsborough's most famous work is *The Blue Boy*, a portrait. It shows Gainsborough's



Brown Bros.

Thomas Gainsborough

preference for cool blue and green colors, in contrast to the reds, yellows, and browns of Reynolds and George Romney.

Gainsborough's portraits are intentionally flattering to the sitter, which was the custom in his day. But he had temperament, and he painted with unusual sensitivity, grace, and charm. In this, he surpasses Reynolds and resembles Sir Anthony Vandyke, who had painted at the English court

more than 100 years earlier. Most critics believe that Gainsborough was best as a painter of women.

Gainsborough was born at Sudbury, Suffolk, the son of a cloth merchant. He showed an early talent for drawing and painting, and at 14, he went to London to study painting. He returned to Sudbury and married at 19. He began selling some portraits, and in 1759, he and his wife moved to Bath, the famous and fashionable bathing resort.

At Bath, Gainsborough won immediate success among the fashionable people who visited the town. He never became a courtier, though. He preferred a country ride on horseback or the company of close friends and his wife to the fashionable life of the town.

In 1768, he was invited to become a founding member of the Royal Academy, and seven years later, he moved to London. He painted portraits of King George III and the royal family, and leading aristocrats, politicians, writers, and actors. Among them were Edmund Burke, William Pitt, Benjamin Franklin, Richard Brinsley Sheridan, Sarah Kemble Siddons, and Samuel Johnson. During his lifetime, Gainsborough painted about 500 such portraits at high fees. His early ones are detailed and tight in style, but later he painted more freely and impressionistically.



Huntington Library and Art Gallery, San Marino, Calif.

Gainsborough's Famous Painting, *The Blue Boy*, was bought by an American in 1928 for \$800,000.

Gainsborough often set his figures in a landscape. It is said that he preferred to paint landscapes, but could not sell them. He did paint a few landscapes that are still highly thought of, such as *The Watering Place* and *The Market Cart*.

LESTER D. LONGMAN

GAISERIC. See **GENSERIC**.

GAIT. See **HORSE** (Gaits).

GAITSKELL, HUGH TODD NAYLOR (1906-), became the leader of the British Labour party when Clement Attlee resigned in 1955. Gaitskell was born in London, and was educated at Winchester School and New College, Oxford. Later, he taught economics at University College in London. He was a temporary civil servant from 1940 until he was elected to the House of Commons in 1945. He served as Minister of Fuel and Power from 1947 to 1950 and Chancellor of the Exchequer in 1950 and 1951.

C. L. MOWAT

GAIUS, or CAIUS, a Roman legal writer of the A.D. 100's, wrote the *Institutes of Gaius*, an explanation of the elements of Roman law. It became the basis for the famous *Institutes of Justinian* (see **JUSTINIAN CODE**). Little is known about Gaius, but his writings help in the study of comparative law and show how some law survived from primitive times. He wrote the *Institutes* between A.D. 130 and 180. The work was lost until 1816, when it was found on a manuscript written over by works of Saint Jerome.

DANIEL J. DYKSTRA

GAIUS PLINIUS. See **PLINY**.

GALACTIC CLUSTER. See **MILKY WAY**.

GALAHAD, SIR, was the noblest knight of the Round Table in the legends of King Arthur. He took the most important part in the search for the Holy Grail, the cup from which Christ supposedly drank at the Last Supper. Sir Galahad is pictured as the ideal young man. He is set apart by his wonderful strength and purity. His qualities are shown in the following lines from Alfred, Lord Tennyson's poem, "Sir Galahad":

My good blade carves the casques of men
My tough lance thrusteth sure,
My strength is as the strength of ten
Because my heart is pure.

There are several versions of the Sir Galahad legend. In one, he is the son of Sir Lancelot and Elaine. In another, he is created by enchantment. In Sir Thomas Malory's version, *Le Morte Darthur* (The Death of Arthur), Sir Galahad, Sir Bors, and Sir Percival see the Holy Grail. After this, the soul of Sir Galahad departs to heaven.

In Tennyson's *Idylls of the King*, Sir Galahad saw a bridge of a thousand piers rising up before him and stretching out toward a great sea. Each pier became a mass of flame as he crossed it. When he had passed far

Sir Galahad, the purest and noblest knight of King Arthur's Round Table, was described in Tennyson's *Idylls of the King*.

From the painting by George Frederic Watts



out on the great sea, he was drawn into a heavenly city whose spires and gateways gleamed white like pearls. Over the city floated the Holy Grail. KNOX WILSON

Related Articles in **WORLD BOOK** include:

Arthur, King Idylls of the King Round Table
Holy Grail Malory, Sir Thomas Tennyson, Lord

GALÁPAGOS, *guh LAH puh gus*, **ISLANDS** lie in the Pacific Ocean 650 miles west of Ecuador, and belong to that country. They are sometimes called the Archipelago of Colón. For location, see **ECUADOR** (color map).

The islands are made up of volcanic peaks and cover an area of 2,966 square miles. They were once known as the Enchanted Isles. Pirates buried their stolen treasure there, and castaways found the islands a refuge.



Location Map of the Galápagos Islands

Mutineers were sometimes left there. Robinson Crusoe (Alexander Selkirk) once visited the islands. About 1,300 persons live there.

Strange birds and animals live in the Galápagos. They include a rare cormorant that cannot fly; the penguin (widely believed to live only in the Antarctic); and mocking birds of a type unknown elsewhere. There are great turtles that weigh more than 500 pounds. The Spanish word for the turtles, *galápagos*, gave the islands their name. Most fantastic of all are the thousands of lizards called *iguanas*. Many of them are 4 feet long. More familiar creatures include herons, sea birds known as *boobies*, and scarlet crabs, which are the same as an Atlantic species from which they have been separated for possibly 35,000,000 years. In 1835, Charles R. Darwin explored the 15 Galápagos Islands. He was impressed by the strange forms of life there.

The five largest islands are Isabela (Albemarle), Santa Cruz (Indefatigable), San Cristóbal (Chatham), Fernandina (Narborough), and San Salvador (James). In 1942, Ecuador allowed United States troops to establish a base on the Galápagos to guard the Panama Canal. The United States returned this base to Ecuador in 1946, after World War II.

H. F. RAUP

GALATA. See **ISTANBUL** (Location and Description).

GALATEA, *gal uh TEA uh*, was a beautiful sea nymph in Greek mythology. She was the daughter of Nereus and Doris, and was often called "the queen of the sea." The ugly one-eyed Polyphemus loved her. But Galatea gave herself to a Sicilian shepherd named Acis. The monster Polyphemus found them together one day and crushed them with a rock (see **POLYPHEMUS**). The blood of Acis was changed into a stream which flowed out to sea to meet Galatea. PADRAIG COLUM

GALATIA, *guh LAY shih uh*, was a Roman province in Asia Minor. It included the central part of the present country of Turkey. The boundaries varied in different periods. Galatia was named for the Gallic tribes (called *Galatai* by the Greeks) that invaded Greece and Macedonia and overran Asia Minor in the 200's B.C. Attalus, King of Pergamum, defeated the Gauls in 239 B.C., and forced them to settle in the part of ancient Phrygia which became Galatia. The Galatians lived in rural areas and made the cities pay tribute to them. They were subdued by the Romans in 189 B.C., but allowed to control their own government. The Romans used them as allies against other groups.

The Emperor Augustus made Galatia a Roman province in 26 B.C. Its chief cities were Ancyra, Pessinus, and Tavium. The region is mentioned frequently in the New Testament. The apostle Paul visited Galatia twice (Acts 16:6; 18:23), and later wrote a letter to the people of the province of Galatia. Paul's letter became known in the Bible as Saint Paul's Epistle to the Galatians.



The Province of Galatia is shown in black.

JOSEPH WARD SWAIN

GALATIANS, EPISTLE TO THE, is the ninth book of the New Testament. Saint Paul wrote it to answer the charge that he was not a true apostle, and to deal with the question of whether Christians must keep the Mosaic Law, at least if they wish to be perfect. He insists that "in Christ" they are free from the Law, but are to be guided by the Spirit. The letter is called the *Christian Declaration of Independence*.

FREDERICK G. GRANT

GALAXY, *GAL uh sih*, is a system of stars. A galaxy is sometimes called a stellar universe, and may include billions of stars. The earth is in a galaxy called the Milky Way, which forms the lane of light we also call by that name. The Milky Way system has a diameter of about 125,000 light-years, and is more than 20,000 light-years thick. A light-year is the distance light travels in a year, or about 6,000,000,000,000 miles. Many astronomers call other galaxies *extragalactic nebulae*.

The Milky Way is believed to be a galaxy of the spiral form, with the sun located about 35,000 light-years from the center of the galaxy. The sun is on the inside of one of the spiral arms that extend out like the arms of a giant pinwheel. The galaxy even rotates like a giant pinwheel, with the outer parts of the arms trailing. It turns around once in about 200,000,000 or 250,000,000 years at the sun's distance from the center.

Studying Galaxies. Astronomers know that billions of galaxies exist, because they can be photographed through high-powered telescopes. The most distant galaxies so far observed by the 200-inch telescope at Mount Palomar are about one billion light-years away. In the constellation of Virgo, there is a great cluster of hundreds of galaxies that extends into the neighboring constellation of Coma Berenices, and into Leo. The Virgo cluster is 8,000,000 light-years away. Such a



Yerkes Observatory

The Galaxy of Stars in the Nebula of Andromeda gives off almost two billion times as much light as our sun. This galaxy is in a constellation named for a maiden in Greek mythology.

cluster of galaxies is sometimes called a *supergalaxy*. The whole universe of galaxies is called the *metagalaxy*.

About 25 degrees from the south celestial pole there are two irregular galaxies that can be seen easily with the unaided eye. They look like luminous clouds, much as the Milky Way does. They are called the Magellanic Clouds, after the great explorer Ferdinand Magellan. They are only about 80,000 light-years away, and are companion, or satellite, galaxies to the Milky Way.

On clear nights, another galaxy can be seen without a telescope in the constellation of Andromeda. This neighboring spiral is 800,000 light-years away. It radiates 1,600,000,000 times as much light as the sun.

Galaxies are usually classified by their appearance. *Irregular systems* have no special form and no symmetry. *Spiral systems* resemble huge pinwheels, with giant arms extending from dense central cores. *Elliptical systems* appear round or elliptical, without the spiral arms. About half of all galaxies are spirals.

Star Clusters are groups of stars that are associated to form clusters which can be seen with the unaided eye or through telescopes. *Open clusters* usually have only a few hundred stars. They are called *moving clusters* if they are close enough to the earth for their motion across the sky to be noticeable in relatively short periods. The Pleiades and the Hyades, both in the constellation of Taurus, the Bull, are the most famous open clusters in the sky.

Globular clusters are much more compact than open clusters. They include tens of thousands of stars arranged in a globelike shape. Only about 100 globular clusters are known in the Milky Way galaxy, but other galaxies have thousands of globular clusters, as well as open clusters.

CHARLES ANTHONY FEDERER, JR.

See also MILKY WAY; NEBULA; STAR.

GALDHÖPIGGEN, or **GALDHÖPIG**. See NORWAY (Land Regions).

GALE is a wind current that is stronger than a breeze but not so strong as a hurricane. The speed of a gale ranges from 39 to 63 miles an hour.

GALE, ZONA (1874-1938), an American fiction writer, wrote of her birthplace, Portage, Wis., in the stories in *Friendship Village* (1908). *Miss Lulu Bett*, dramatized from her novel by that name, won a 1921 Pulitzer prize. Miss Gale returned to Portage in 1905 after being a journalist in New York City. She wrote of leisurely neighborliness in a series of books on that town. But in *Birth* (1918), she also showed that life in such towns is occasionally bleak and repressed. HARRY H. CLARK

GALEN, *GAY* lun (A.D. 138?-201?), **CLAUDIUS GALENUS** in Latin, is often called the father of experimental physiology. His important contributions rank him second to Hippocrates in the history of medicine. Galen discovered that arteries contain blood and not air as had been taught up to his time. He also knew the heart set the blood in motion, but he failed to discover how the blood circulates through the human body.



Brown Bros.

Galen

Galen was born in Pergamum (now Bergama, Turkey). After studying philosophy in Pergamum, he spent the next 10 years studying and practicing medicine in Smyrna, Phoenicia, and parts of Greece. He studied anatomy at the famous medical school in Alexandria, Egypt. He returned to Pergamum and was appointed a surgeon of gladiators.

His fame spread, and he went to Rome. Galen gave lectures in the public theater and performed experiments on animals before large audiences. Because human dissection had become illegal, he used pigs and Barbary apes for his demonstrations in anatomy and physiology.

Galen wrote more than 400 books, but only 83 remain. These have been translated into many languages. One of the best-known books is *On the Natural Faculties*. Unfortunately, his writings contain many errors. Because his authority was unquestioned, these errors were accepted by physicians and scholars throughout the Middle Ages.

CAROLINE A. CHANDLER

See also MEDICINE (History of Medicine).

GALENA, *guh LEE nuh* (chemical formula, PbS), the chief ore of lead, is a heavy, brittle, lead-gray mineral with a metallic luster. Galena is a sulfide of lead. The pure mineral contains about 86.6 parts of lead and 13.4 parts of sulfur by weight.

The chief sources of this mineral are Mexico, Spain, Canada, the Harz Mountains of Germany, and the United States. In the United States, galena is found in Missouri, Idaho, Illinois, Iowa, Wisconsin, Colorado, and Montana. *Argentiferous galena* contains considerable silver besides the lead and sulfur. Industry sometimes uses this kind as an ore of silver. Coarsely grained galena, used to glaze pottery, is called *potter's ore*. A. PABST

See also LEAD.

GALESBURG, Ill. (pop. 37,243; alt. 773 ft.), is the trading and railroad center for a rich farming region. The city lies about 160 miles southwest of Chicago (see ILLINOIS [color map]). Galesburg is the home of Knox College. A group of people from Oneida, N.Y., founded the town and college in 1837. The fifth Lincoln-Douglas debate occurred there in 1858. Poet Carl Sandburg was born in Galesburg in 1878. The city has a council-manager form of government.

PAUL M. ANGLE

GALICIA, *guh LISH ih uh*, is a region in Central Europe which lies west of the Ukraine in Russia, and north and east of Romania, Hungary, and Czechoslovakia. It covers about 30,000 square miles. The region extends along the northern slopes of the Carpathian Mountains to the valleys of the Dnestr and Vistula rivers.

About 7,000,000 people live in Galicia. More than half are Ruthenians, and most of them live in eastern Galicia. Many Polish people live in the western part.

Agriculture is the chief industry. Crops include corn, hay, potatoes, sugar beets, and wheat. Minerals found in Galicia include coal, iron, lead, petroleum, salt, sulfur, and zinc.

The principal cities are Kraków and Lvov, or Lwów.

Galicia was an independent kingdom in the early Middle Ages. It became part of Poland in the 1300's, and fell to Austria at the time of the first division of Poland in 1772. Galicia became a province in the Austro-Hungarian Empire and was given some control over its internal affairs.

During World War II, Germany first occupied western Galicia after Poland's defeat. In 1941, Germany

GALILEE, SEA OF

took possession of all of Galicia. Later, Russian troops occupied the entire region. After the war, eastern Galicia came under Russian control, and western Galicia remained under Polish rule.

M. KAMIL DZIEWANOWSKI

GALILEE was the most northern part of Palestine in Roman times. It lay between the River Jordan and the Sea of Galilee on the east, and the Mediterranean Sea on the west. The region is now part of the state of Israel. The name Galilee comes from the Hebrew word *galil*, which means *circle*. The Hebrews living in the region were surrounded by Gentiles who moved there after the fall of Samaria in 722 B.C. The area was originally named for the Hebrew tribes that had settled there, Zebulun and Naphtali.

Galilee has permanent interest for Christians as well as Jews. Many of the important events in the life of Jesus Christ took place in the region. Jesus' home was in Nazareth, a hillside town in southern Galilee. Most of His apostles came from Capernaum, Bethsaida, and other towns around the Sea of Galilee. According to the Book of Tobit in the Apocrypha, Tobit's son Tobias lived in Galilee (see APOCRYPHA).

The people of Galilee were strong, brave, and industrious. They sold their fish, grain, wine, olive oil, and fruit to other countries, especially Egypt. After the Romans destroyed Jerusalem in A.D. 70, many Jews took refuge in Galilee. The area became famous as a center of learning.

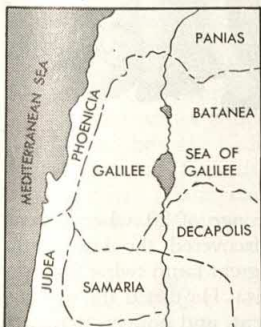
FREDERICK C. GRANT

See also NAZARETH; SEA OF GALILEE.

GALILEE, SEA OF. See SEA OF GALILEE.

HISTORIC GALILEE

Famous Places and Events



Ancient Galilee lay on the eastern end of the Mediterranean Sea, above. The Sea of Galilee formed part of its eastern border. Many important Biblical events took place in Galilee, right.





Galileo and the Swinging Lamp.

Galileo discovered the law of the pendulum when he was only 20 years old. He timed the swings of a lamp in the cathedral at Pisa and observed that each swing took the same time, whether the arc was large or small. The bronze lamp of Galileo, above, hangs in the cathedral. The fresco, right, was painted by Luigi Sabatelli about 1840.

Alinari; Museo di Fisica e Storia Naturale, Florence, Italy (Alinari)

Galileo



GALILEO, *GAL uh LEE oh* (1564-1642), an Italian astronomer and physicist, has been called the founder of modern experimental science. He made the first practical use of the telescope to discover many new facts about astronomy. Galileo discovered the law of the pendulum and is credited with discovering a famous law of falling bodies. He also invented a hydrostatic balance used in physics, designed the sector to aid draftsmen, and improved the telescope.

Early Interests. Born Galileo Galilei in Pisa on Feb. 15, 1564, he showed unusual skill in building toys as a child. He also played the lute and the organ well, and won a reputation for his excellent paintings. His merchant father, bewildered by Galileo's varied interests, encouraged him to become a doctor. He studied medicine and the philosophy of Aristotle at the University of Pisa.

Young Scientist. Galileo made his first important

scientific contribution at the age of 20, when he was a university student. He discovered the law of the pendulum while watching a great lamp swing from the ceiling of the cathedral in Pisa. He timed the motions of the lamp with his pulse beat, and noticed that each swing took the same amount of time. Later, he suggested the use of a simple pendulum to time the pulse rate of medical patients. Christian Huygens, a great Dutch mathematician, also applied the principle in building astronomical clocks. See **PENDULUM**.

Galileo left the university in 1585 because he lacked money. He abandoned medicine for research in mathematics. During this time, he invented the hydrostatic balance, which is used to find the specific gravity of objects by weighing them in water (see **GRAVITY**, **SPECIFIC**).

Galileo returned to the University of Pisa at the age of 25 as professor of mathematics. During this period,

he is credited with discovering a famous law of falling bodies (see FALLING BODIES, LAW OF). He evidently reasoned that gravity pulls all bodies to earth with the same acceleration, regardless of their weight. According to an often-disputed story, he dropped a 10-pound and a 1-pound weight from the top of the Leaning Tower of Pisa. A crowd of students, professors, and priests looked on as both weights struck the ground at about the same time, proving Galileo's theory correct. The story, however, is thought by many to be untrue in its details, although Galileo might have dropped two unequal weights at some time. Followers of Aristotle, who said heavy bodies fell faster than lighter ones, bitterly opposed Galileo's new theory. Galileo was forced to leave the university.

His Discoveries in Astronomy. In 1592, Galileo became professor of mathematics at the University of Padua. He taught there for 18 years. His fame as the greatest experimental physicist of his time attracted students from all parts of Europe. His historic achievements in astronomy followed. In 1597, Galileo invented the *sector*, a type of compass still used by draftsmen. Beginning in 1609, he built many telescopes and sold them throughout Europe (see TELESCOPE). He also made larger and more powerful telescopes than had been made before.

Galileo's first important observations in astronomy concerned the moon, and opposed the teachings of Aristotle. Galileo discovered that the moon was not a smooth sphere shining by its own light. He observed that its surface was marked by valleys and mountains, and that it showed only the light it reflected. He also studied the Milky Way. He ignored fables and superstition about its nature. His observations indicated that the Milky Way was a mass of stars "so numerous as to be almost beyond belief."

He made his most sensational discovery, the four bright satellites of Jupiter, in 1610. He named these the Medicean stars, after the Medici family, who ruled the province of Tuscany, where he was born (see JUPITER [planet]). That same year, he observed the peculiar form of Saturn. Its rings were recognized several years later by Christian Huygens.

These discoveries added support to the Copernican system, and brought Galileo added fame (see COPERNICUS, NICOLAUS). They also brought him extreme abuse. Most leaders of European thought at that time were suspicious of anyone who dared speak against popular

belief based on the teachings of the ancient wise men. Many churchmen and followers of Aristotle opposed Galileo. But Cosimo II, a member of the Medici family and grand duke of Tuscany, became his patron, or protector. He invited Galileo to serve as his personal mathematician at Florence and the University of Pisa. Galileo accepted the invitation.

At Florence, Galileo detected the phases of Venus (similar to the phases of the moon) and a slight phase of Mars. On a visit to Rome, he used one of his own telescopes to show Pope Paul V and other high church officials what he had discovered. In spite of these demonstrations, a dispute followed between churchmen and scientists. The Church also bitterly opposed Galileo's report on sunspots.

Galileo firmly upheld the theory of Copernicus that the earth moves around the sun. Church officials warned Galileo to abandon the Copernican system. At the same time, the Church placed the work of Copernicus on the *Index* of prohibited books, where it remained for 200 years.

The Inquisition. In 1632, Galileo published his masterpiece, *A Dialogue on the Two Principal Systems of the World*. The Holy Office, or Inquisition, immediately called him to appear before it (see INQUISITION). After a long trial, Church officials forced him to say that he gave up his belief in the Copernican theory, and sentenced him to an indefinite prison term. Instead of imprisoning Galileo, they confined him to his villa in Florence.

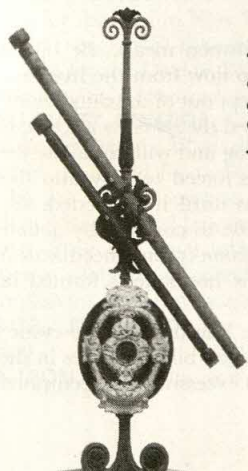
He spent his last years writing on the laws of force and motion (see DYNAMICS). He published *Dialogues on the Two New Sciences* in 1638. It summed up his life's work on motion, acceleration, and gravity, and furnished a basis for the three laws of motion laid down by Sir Isaac Newton in 1687.

Before Galileo published his *Dialogues*, he became blind. He lived only five more years, but the Inquisition constantly watched him in his home during that time. He was buried in the Church of Santa Croce in Florence. Fifty years after his death, the city erected a monument at the church in his honor. CARL T. CHASE

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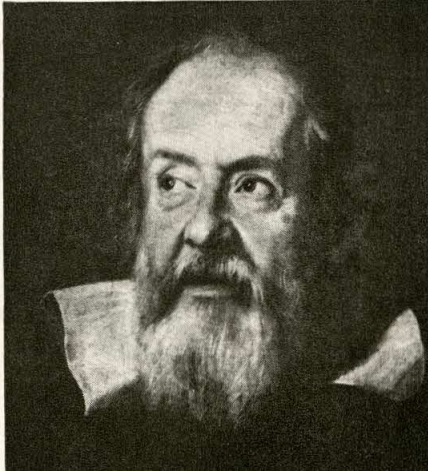
Copernicus,	Falling Bodies, Law of	Pendulum
Nicolaus	Gravity, Specific	Physics
Dynamics	Inquisition	Telescope

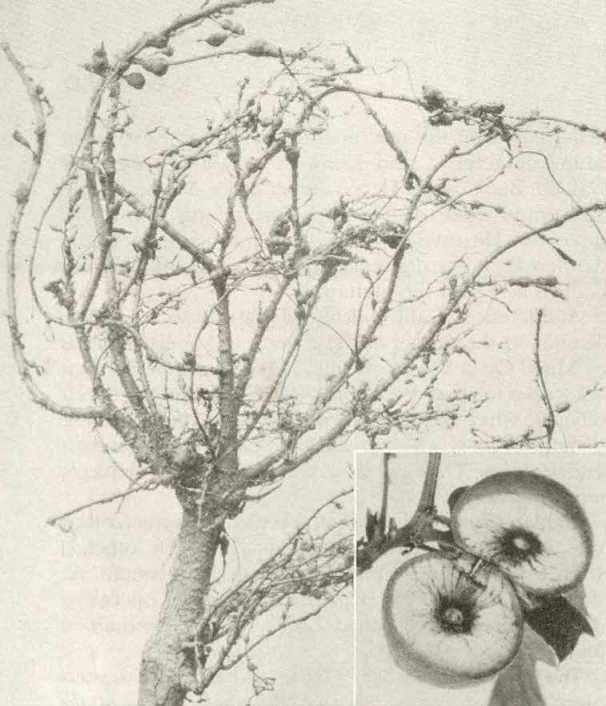
Uffizi Gallery, Florence, Italy (Alinari)



Two of Galileo's Telescopes are displayed in a museum in Florence. A lens from the telescope Galileo used when he discovered Jupiter's moons is on the plaque.

Portrait of Galileo. Justus Sustermans painted this portrait about 1636. Galileo was about 72 years old, and was writing about his life's work. Afterwards, Galileo became blind.





J. Horace McFarland; Hugh Spencer

Root Gall attacks the roots of peach trees and often causes serious damage. A cross-section of an oak gall, inset, shows how it grows around the larva of a gallfly and protects it.

GALL, *gawl*, is an unnatural growth on a tree or flower that is caused by the young larvae of insects, and sometimes by worms, fungi, slime molds, or bacteria. The gall may be on a root, a stem, a flower bud, a leaf, or a flower.

Galls have many different shapes. Some are smooth and round, like tiny balls. Others are rough and hairy. Some are shaped like tiny pine cones, or like a cluster of pointed stars. No one knows exactly how they grow or why. An insect deposits an egg inside the plant tissue. After the egg hatches and the larva comes out, the plant tissue around the larva is stimulated in some mysterious way, and it develops rapidly into a gall around the larva. Some galls contain only one larva, while others have as many as a dozen. The galls vary in size from slight swellings to large growths several inches in diameter. Birds, squirrels, and insects often tear open the galls and eat the larvae inside, but many of the galls protect the larvae. Some galls produce juices that trap invading insects. Others contain a substance called *tannin*, which is very bitter.

Many insects that produce galls are harmful to plants. The Hessian fly does millions of dollars worth of damage to the wheat crop in the United States and Canada each year. But some galls are valuable. The four-winged gallfly larva makes a spongy "apple" gall on oak trees, which contains tannin. These galls are used in leather tanning. They are also made into ink and dyes and often used in medicine. The galls used in commerce are gathered by people in parts of Italy, Iran, Cyprus, Asia Minor, and Syria.

L. B. AREY

Related Articles in WORLD BOOK include:

Bacteria	Gallic Acid	Slime Mold
Eelworm	Hessian Fly	Tannic Acid
Fungi	Ink	

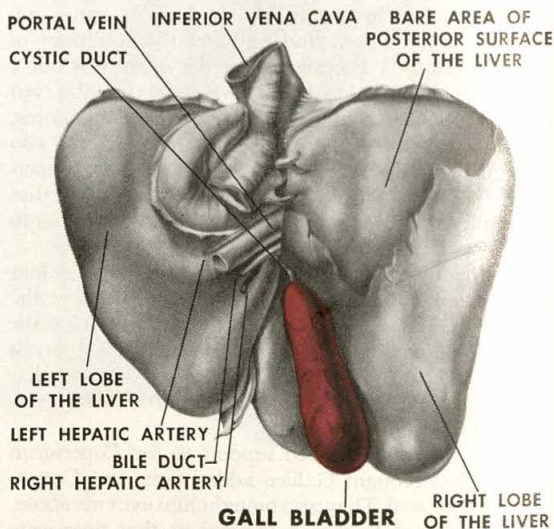
GALL, FRANZ JOSEPH (1758-1828), a German anatomist, founded the pseudo science of phrenology. He believed that each of the functions of the mind has its own place in the brain, and that a person's mental and moral characteristics could be determined by examining the shape of his head. He wrote, with Johann Kaspar Spurzheim, the four-volume *Anatomy and Physiology of the Nervous System* (1810-1820). Modern research has proved phrenology physiologically unsound. Gall was born at Tiefenbrunn, Germany.

KENNETH E. CLARK

See also PHRENOLOGY.

GALL BLADDER is a small pouch that stores bile. Many, but not all, animals with backbones have gall bladders. In human beings, the gall bladder is a pear-shaped sack that rests on the underside of the right portion of the liver. The gall bladder can hold about 1½ ounces of bile at one time.

The neck, or *stem*, of the gall bladder, connects with a tube called the *cystic duct*, which enters the *hepatic duct* from the liver. Together, these tubes form the *common bile duct*. During digestion, bile flows from the liver through the hepatic duct into the common bile duct and empties into the *duodenum*, which is the first section



The Gall Bladder Lies Under the Right Side of the Liver.

of the small intestine. Between meals, the bile is not needed but it continues to flow from the liver into the common bile duct. It is kept out of the duodenum by a small, ringlike muscle called the *sphincter of Oddi*, which tightens around the opening and will not allow the bile to pass. The fluid then is forced to flow into the gall bladder, where it remains until it is needed.

The gall bladder is made to contract by action of a hormone called *cholecystokinin* (pronounced *KOH lee sis toh KY nin*). Most of this hormone is formed in the body from fats.

Diseases that block the bile duct or the cystic duct are often quite painful. When bile stagnates in the gall bladder, the bile becomes excessively concentrated and

gallstones form. Sometimes surgeons must remove the gallstones by operating.

ANDREW CONWAY IVY

Related Articles in WORLD BOOK include:

Bile	Gallstone	Intestine	Liver
Digestion	Hormone	Jaundice	

GALLATIN, ALBERT (1761-1849), was a statesman, financier, and diplomat during the early years of the United States. He was born in Geneva, Switzerland, and was educated at the University of Geneva. In 1780, he came to America and took part in the Revolutionary War. For a time, he taught at Harvard College. In 1786, he moved to Pennsylvania, became a member of the state legislature, and began writing sharp criticisms of Alexander Hamilton's financial program. He was active in settling the Whisky Rebellion (see **WHISKY REBELLION**).

Gallatin was elected to the United States House of Representatives in 1795. He became an active supporter of Thomas Jefferson. In 1801, Jefferson appointed him Secretary of the Treasury, and Gallatin began to reduce spending and pay off the national debt. He opposed the War of 1812, and negotiated the Treaty of Ghent, which ended the war (see **GHEENT, TREATY OF**). He served as United States minister to France from 1815 to 1823, and in 1826 was minister to Great Britain.

Gallatin founded the Ethnological Society of America in 1842. He was its first president, and wrote several books on American Indian tribes.

W. B. HESSELTINE

GALLAUDET, *GAL uh DEHT*, is the family name of three American educators, father and two sons, who pioneered in educating the deaf and dumb in the United States.

Thomas Hopkins Gallaudet (1787-1851) became interested in teaching four-year-old deaf and dumb Alice Cogswell, and was sent by her father and others to study in Europe. There, he was discouraged from learning the oral method developed in England, and brought back instead the manual, or sign method, favored in France. Gallaudet founded the Hartford (Conn.) School for the Deaf in 1817, and wrote many children's books. He was born in Philadelphia.

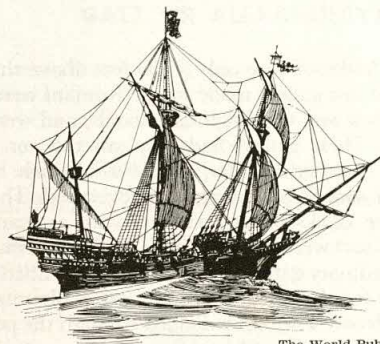
Thomas Gallaudet (1822-1902), the older son, opened a church for the deaf in New York City. **Edward Miner Gallaudet** (1837-1917), the younger son, opened Gallaudet College for the Deaf in Washington, D.C., in 1864. Both were born in Hartford, Conn.

ALAN KEITH-LUCAS

GALLAUDET COLLEGE is a private, coeducational liberal arts college in Washington, D.C. It is the only college in the world for the deaf, and was founded in 1864 by an act of Congress. Courses are taught by speech and the manual language of the deaf. The Hearing and Speech Center offers exceptional research facilities in problems of speech, hearing, and deafness. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GALLE, JOHANNG. See **ASTRONOMY** (New Discoveries).

GALLEON, *GAL ee un*, was at first an Italian armed



The World Publishing Co.

The Galleon Helped Establish English Naval Power.

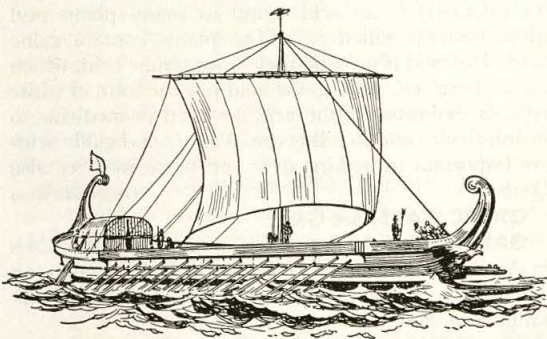
merchant ship. It had oars like a galley, but was shaped like the "round ship" used in the coasting trade. King Henry VIII of England developed the galleon into a strictly fighting ship. It was easily maneuvered and swift, compared with other ships of its day. It was the largest ship in the English Navy. The early fighting galleon had a heavy front mast, or *foremast*. The *mainmast*, or mast placed next behind the foremast, was also heavy. Both foremast and mainmast carried deep, square sails. Galleons also had one or two small masts toward the rear of the ship. These masts held three-cornered sails, called *lateen* sails. A long, raised deck, called the *quarterdeck*, ran from the mainmast toward the rear of the ship, where a still higher deck, called the *poop*, was located. The *forecastle*, or raised deck in front of the foremast, was square and rather low.

The sides of galleons of Henry VIII's day were usually pierced for a dozen large guns. A few smaller guns were mounted above the main deck. The Spanish galleon, which appeared about 1550, had a higher and longer poop than the English galleon, and was less manageable. The Spaniards tried the ship for carrying treasure from the Americas during the latter 1500's. But it could not defend itself against the many pirate ships that sailed the seas, because it was too hard to maneuver. For valuable cargoes, the Spanish galleon was replaced by treasure-frigates.

WILLIAM W. ROBINSON

See also **GALLEY**; **SHIP AND SHIPPING** (color picture, Early Ships).

GALLEY was a long, open warship used by the navies of ancient Mediterranean nations. These ships were moved through the water by means of long oars in rows. They usually had only one deck, and the side of the



A Roman Galley Moved Both by Oars and by Sail. The oars were usually pulled by slaves chained to their seats.

GALLFLY

ship, or *freeboard*, rose only a few feet above the waterline. The first galleys made by the Romans were copied from Greek and Carthaginian models, and were called *uniremes*. These galleys had only one row, or *bank*, of oars on each side. Later, the *bireme*, which had two banks of oars on each side, was developed. The *trireme* had three banks of oars. Galleys with as many as 40 banks of oars were built, but were too hard to maneuver.

The ordinary galley had about 50 oars. Each oar was 40 to 50 feet long. Six men were generally required to pull each oar. The oars extended through the portholes, generally in groups of four. War galleys usually had two or three masts. Guns were mounted at either end of the ship. The galleys carried more than 1,000 men. In ancient times, the rower's position was considered an honorable one. Later, slaves, prisoners of war, or condemned criminals were used at the oars. The Greek and Roman galleys had a sharp point, or *ram*, that projected from the *bow*, or front, of the ship.

Today, the word *galley* is used to mean the kitchen aboard ship and in airliners.

ROBERT COLBORN

See also ANCIENT CIVILIZATION (Tools); TRIREME.

GALLFLY. See FLY (Flies That Harm Plants); GALL.

GALLI-CURCI, GAHL uh KOOR chee, **AMELITA** (1889-), an Italian opera singer, made her operatic debut

before she took a voice lesson. She attended the Royal Conservatory in Milan, Italy, and won honors as a piano student. But she felt sure that she possessed an exceptional coloratura soprano voice and began to teach herself. Her debut in 1909, as Gilda in Giuseppe Verdi's *Rigoletto*, was a brilliant success. During the next six years, she sang in Italy and Spain. Critics praised her voice for its range and clarity. Galli-



Culver

Amelita Galli-Curci

Curci sang with the Chicago Opera Company from 1916 to 1924 and with the Metropolitan Opera Company in New York City from 1920 until her retirement in 1930. She was born in Milan.

DANIEL A. HARRIS

GALLIARD. See DANCING (The Renaissance).

GALLIC, GAL ick, **ACID** (chemical formula, $C_6H_2(OH)_3CO_2H$) is an acid found in many plants and plant growths called *galls*. Tea plants contain gallic acid. The acid is usually made from tannic acid, which comes from tea. Solid gallic acid has the form of white crystals. Solutions of the acid are used in medicine to shrink tissues and to kill germs. Tannic and gallic acids are important in making dyes and black ink. See also GALL.

GEORGE L. BUSH

GALLIC WARS. See GAUL.

GALLINULE, GAL ih nyool, is a water bird that lives in America and Europe. In Great Britain, the common gallinule of Europe is called *water hen*, or *moor hen*. Gallinules are close relatives of the coots.

The *Florida gallinule*, which lives as far north as Ontario, is sooty-colored or black. It looks like a coot, but has a broad red plate covering its forehead like a shield.

Its bill is red instead of white like the coot's. The *purple gallinule* breeds from the southern United States to South America. Both these birds are a little more than a foot long. They live in marshes, where they build rough platforms for their nests. They lay from 6 to 14 eggs of different colors, and have loud voices like a hen's.

Even though they do not have webbed feet, gallinules are excellent swimmers. But they are poor fliers. During the day they hide in marsh grasses.

Scientific Classification. Gallinules are in the rail family, *Rallidae*. The European gallinule is genus *Gallinula*, species *chloropus*, subspecies *chloropus*. The Florida gallinule is *Gallinula chloropus cachinnans*, and the purple, *Porphyryla martinica*.

JOSEPH J. HIGKEY

See also BIRD (color picture, Water Birds); MUD HEN; RAIL.

GALLIOLI, guh LIP oh lee, **PENINSULA**, once called *Chersonesus Thracica*, is a long, narrow land point of the Turkish province of Adrianople. The peninsula is most important for its strategic military position, because it controls the Dardanelles Strait, the only entrance into the Black Sea. In 1854, during the Crimean War, French and British troops landed on the Gallipoli Peninsula to protect Turkey from Russia.

In 1915, French, British, Australian, and New Zealand troops landed on the peninsula to attack Turkey, but were thrown back in a bloody defeat. Winston



Gallipoli Peninsula Controls the Dardanelles Strait.

Churchill, First Lord of the Admiralty, was blamed for the defeat. See WORLD WAR I (The Dardanelles).

The peninsula has many mountains. Farmers harvest large corn crops in the valleys, and grow grapes on the slopes of the hills. A town named Gallipoli is on the peninsula, about 120 miles from Istanbul. In 1929 the Turkish government renamed both town and peninsula Gelibolu.

W. ELMER EKBLAW

GALLIUM, GAL ih um (chemical symbol, Ga), is a metallic element. Its atomic weight is 69.72, and its atomic number is 31. The French chemist Paul Émile de Boisbaudran discovered it in 1875 while conducting experiments in spectrum analysis. Gallium was first found in zinc ore near Pierrefitte in the Pyrenees Mountains of France, and was named after Gallia, the ancient name of France. Gallium is a rare, grayish-white, hard metal. It can be hammered into thin plates which can be bent several times without breaking. Gallium melts by the mere warmth of the hand (about 86°F.). Its general properties resemble those of aluminum. Gallium combines with oxygen to form oxides, and with chlorine to form several kinds of chlorides. The metal has no commercial use.

HARRISON ASHLEY SCHMITT



8 PINTS



4 QUARTS



1 GALLON

The Standard Gallon used in the United States contains 8 pints or 4 quarts.

GALLON, GAL *un*, is a unit of measurement used for liquids. It is a standard measurement in the United States, Canada, and England. A gallon is the amount of liquid that will fill a container of 231 cubic inches. A cylinder 6 inches long and 7 inches in diameter will hold almost exactly 1 gallon. A fourth of a gallon is called a liquid quart. A half-quart is called a pint. A pint equals 4 gills. The *imperial gallon*, used in England and Canada, equals 277.420 cubic inches of liquid, or about $1\frac{1}{8}$ regular gallons. E. G. STRAUS

See also PINT; QUART; WEIGHTS AND MEASURES.

GALLOP. See HORSE (Gaits).

GALLOWAY is a district in the southwestern part of Scotland. It is important as a cattle-breeding area, especially for its black hornless cattle. Farmers also breed a small sturdy horse called the Galloway.

Britons lived in Galloway until the Anglo-Saxons overran the area in the 600's. Invaders from Ireland settled in Galloway in the 800's. They gave the area its name, which means *country of the Gael*.

The district became a permanent part of Scotland in the 1100's, under Alexander II.

ROBERT S. HOYT

GALLOWAY. See CATTLE (Other Beef Cattle).

GALLSTONE is a hard object like a stone or pebble that forms in the gall bladder or bile duct. Gallstones are largely made of *cholesterol*, a kind of alcohol that is normally found in animal fats, bile, blood, the liver, and other tissues. In certain diseases of the liver or gall bladder, cholesterol, together with bile pigments, mineral salts, and other body products, hardens into these stones.

When the gall bladder contracts, a stone may become caught in one of its ducts and cause great pain. A small stone may pass from the gall bladder to the common bile duct and cause pain or fever. The flow of bile into the duodenum may be cut off, causing jaundice, or yellowing of the skin and body tissues.

A surgical operation is often necessary to remove gallstones. Persons with gallstones sometimes develop cancer of the gall bladder.

E. CLINTON TEXTER, JR.

See also CHOLESTEROL; GALL BLADDER; JAUNDICE.

GALLUP, GAL *up*, N.Mex. (pop. 14,089; alt. 6,505 ft.), is called the Indian capital because it is the trading center of the Southwest tribes. Gallup lies about 135 miles west of Albuquerque (see NEW MEXICO [map]).

GALT, SIR ALEXANDER TILLOCH

The Navaho, Zuni, and Hopi reservations are nearby. The Inter-Tribal Indian Ceremonial, an all-Indian event, is held in Gallup each August. South of Gallup lie the ancient ruins of Hawikuh, one of the legendary Seven Cities of Cibola visited by Coronado in 1540. Gallup was founded in 1879. It has a mayor-council government. The chief industries are transportation, clay products, and Indian trading.

FRANK D. REEVE

GALLUP, GEORGE HORACE (1901-), an American statistician, specializes in public opinion and business surveys. His Gallup Poll on political issues and the popularity of politicians became well known. He predicted correctly the outcome of the 1936 presidential election. This success helped to boost his reputation for accuracy. He developed a method of measuring reader interest in news features and advertising. In 1935, he founded the American Institute of Public Opinion at Princeton, N.J. Gallup was born in Jefferson, Iowa, and was graduated from the University of Iowa.

DUDLEY DILLARD

GALLUP POLL. See POLL OF PUBLIC OPINION (History).

GALSWORTHY, GAWLZ *wur thih*, **JOHN** (1867-1933), was one of the most important British novelists and dramatists of his time. He received the 1932 Nobel prize for literature. His novels and plays usually protested against social injustice. They also rank high as literature. His most important work was his series of novels about the Forsyte family. The main character, Soames Forsyte, became so well known that when Galsworthy wrote of his death, *The Times* of London headlined it.

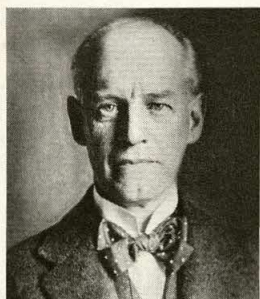
Galsworthy had been writing for almost 10 years when his first novel about the Forsytes, *The Man of Property*, was published in 1906. This book showed his ability as a critic of middle-class life. It was followed by *In Chancery* (1920) and *To Let* (1921). The three books were published in one volume, *The Forsyte Saga* (1922). He continued the Forsyte family's record in *The White Monkey* (1924), *The Silver Spoon* (1926), and *Swan Song* (1928), which were published together as *A Modern Comedy* (1928).

The Silver Box, Galsworthy's first play, was produced at the Court Theatre, London, in 1906. His other plays include *Strife* (1909), which deals with industrial troubles, and *Justice* (1910), a play about prison life. Galsworthy was born in Surrey, and educated at Harrow and Oxford.

R. W. STALLMAN

GALT, gawlt, **SIR ALEXANDER TILLOCH** (1817-1893), was the first prominent Canadian official to propose a tariff on British imports, and one of the first to work for Canadian confederation. He served as commissioner of the British American Land Company from 1844 to 1855, Canadian Minister of Finance three times, and Canadian High Commissioner to Great Britain from 1880 to 1883. Galt was born in London, and came to Canada in 1835.

W. R. WILLOUGHBY



Brown Bros.

John Galsworthy



Brown Bros.

Sir Francis Galton

GALTON, GAWL tun, SIR FRANCIS (1822-1911), a British scientist and cousin of Charles Darwin, became known for his researches in meteorology, heredity, and anthropology. He spent five years in the Sudan and South-West Africa studying the inhabitants of the areas. The Royal Geographical Society gave him its gold medal for his account of his travels. Galton suggested important theories in meteorology,

published weather charts, and introduced the idea of anticyclones (see **CYCLONE**). His studies of fingerprints led to their use in identification (see **FINGERPRINTING** [History]).

Galton argued that plants and animals vary according to patterns. He devised new statistical methods and applied them to the study of heredity. He was the first to call the science of human breeding *eugenics*. Galton urged the planned improvement of the human race by selection of superior parents. In his will, he left money to found the Chair of Eugenics at London University (see **EUGENICS**).

Galton was born near Birmingham, and was educated at Birmingham General Hospital and Cambridge University. He wrote *Hereditary Genius* (1869), *English Men of Science* (1874), and *Inquiries into the Human Faculty and Its Development* (1883). MORDECAI L. GABRIEL

GALVANI, gahl VAH nee, LUIGI (1737-1798), an Italian anatomist, pioneered in *electrophysiology*, the study of the relationship between living organisms and electricity. He was ridiculed when he first observed the muscular twitching of frogs' legs suspended by copper hooks over an iron railing. But his discovery that a muscle could be made to contract by an electric current laid the foundation for the study of animal electricity, an important part of neurophysiology. See **ELECTRICITY** (Flowing Electricity).

Galvani studied and practiced medicine in Bologna, where he was born. He refused to take the oath of allegiance to the Cisalpine Republic, a north Italian puppet state set up by Napoleon I, and was removed as professor of anatomy at the University of Bologna. He was reinstated just before he died. Such terms as *galvanism* reflect his importance.

CAROLINE A. CHANDLER

GALVANIZED IRON AND STEEL. Iron and steel articles sometimes are coated with zinc to prevent them from rusting. In the early 1800's, wrought iron coated with zinc became known as *galvanized iron*. Later, when steel products also were coated with zinc, the name galvanized iron continued to be used to describe them. At the present time, much more steel than iron is coated with zinc.

Steel or iron articles that have been cleaned with acid are galvanized by dipping them in a bath of melted zinc. This process is called *hot-dip galvanizing*. Manufacturers use it to coat steel sheets, pails, pipes, nails, wire, and other products. When the zinc cools on the

product, it leaves small drops of zinc, or crystals, on the surface of the iron or steel. This gives galvanized iron a spotted, or mottled, appearance.

Steel or iron articles also are galvanized by placing them in a solution in which zinc or zinc salts are dissolved. With the aid of electricity, the zinc is transferred, or *plated*, onto the articles. This process is called *electroplating*. Although the use of electricity in galvanizing is a modern development, the first zinc-coating process was named after the Italian scientist Luigi Galvani. Galvani in the late 1700's made some of the pioneering studies of electricity.

Galvanized iron is used mostly to make plain and ridged sheets for the roofs and sides of buildings. It is used widely for buildings in tropical and semitropical countries where the damp air rusts metals and rots wood quickly. Sulfurous compounds destroy the finish of galvanized iron. For this reason, it should not be placed where it will come in contact with smoke containing a large amount of sulfur.

The French used a method of making iron rust-proof by coating with zinc as early as 1742. An Englishman, H. W. Craufurd, obtained the first patent for galvanizing iron in 1837.

WALTER R. WILLIAMS, JR.

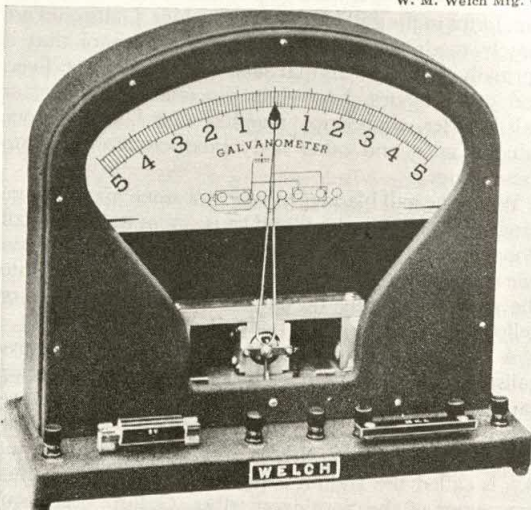
See also **ELECTROPLATING**; **RUST**; **ZINC**.

GALVANOMETER, GAL vuh NAHM ee tur, is a delicate instrument used to detect and measure the strength of an electric current. There are several kinds of galvanometers, but the operation of most of them is based on the fact that an electric current flowing in a wire sets up a magnetic field around the wire. See **ELECTROMAGNETISM**.

A galvanometer usually has a scale with numbers at regular intervals, but the numbers do not represent any particular units of current. The stronger the current detected, the farther a needle or a beam of light moves across the scale. When the scale is marked to show standard units of current, the instrument is called by another name, such as ammeter, milliammeter, or microammeter (see **AMMETER**).

A Galvanometer detects and measures the strength of an electric current. The current makes a needle move across the dial.

W. M. Welch Mfg. Co.



The D'Arsonval Galvanometer is one of the most commonly used galvanometers. In this instrument, a coil made of fine wire hangs between two poles of a permanent magnet. The coil hangs from a small wire that acts as a spring and carries the current from one outside terminal. A spiral wire at the bottom of the coil carries the current to the other terminal. An iron core inside the coil concentrates the magnetic field of the permanent magnet. A mirror attached to the coil reflects a beam of light so that it forms a spot on the scale.

If there is no current, the spring keeps the coil in a neutral position, and the reflected beam of light shines on the "zero" reading of the scale. But when current flows through the coil, the reaction of its magnetic field with the magnetic field of the permanent magnet makes the coil turn. The attached mirror also turns and the reflected beam of light records the extent of the turn on the scale. Sometimes a needle is attached to the coil to take the place of the mirror and the beam of light.

Other Types. Most instruments used for measuring direct current use the moving-coil principle of the D'Arsonval galvanometer. For example, a D'Arsonval galvanometer can be modified and provided with a suitable scale to make a direct-current ammeter.

In another type of galvanometer, the coil remains stationary. But a small magnetic needle is suspended so that it turns when a current flows through the coil. If the magnetic needle is replaced by a soft iron needle, the galvanometer can be used to measure alternating current.

BENJAMIN J. DASHER

See also KELVIN; LORD; POTENTIOMETER; VOLTMETER; WHEATSTONE BRIDGE.

GALVESTON, GAL *vus tun*, Tex. (pop. 67,175; alt. 5 ft.), is one of the world's great sulfur and cotton ports. It is also a resort and amusement center, with 32 miles of beaches and a \$2,000,000 pleasure pier. Galveston lies on the eastern end of Galveston Island, about two miles off the Texas shore in the Gulf of Mexico. The island is about 32 miles long and 2 miles wide. For location, see TEXAS (color map).

Galveston is one of the busiest ports in the United States. It has been called *The Port of Quickest Dispatch* because it lies nearer to deepwater shipping lanes than any other port in the country. It ranks as the world's largest sulfur port and a leading cotton and wheat port. Raw sugar, bananas, and jute are also received in large quantities.

The city's chief industries include cotton compressing, dock repairing, producing industrial chemicals, shipbuilding, and tea blending. Galveston has fisheries, machine shops, and a tin smelter. Pelican Island, a 4,000-acre tract on Galveston's deepwater harbor channel, has been developed as an industrial site. A \$6,000,000 industrial causeway between Pelican Island and Galveston was completed in 1958.

Two causeways link Galveston and the Texas mainland. One accommodates four lanes of automobile traffic. The other carries two traffic lanes, railroad traffic, and gas and water mains. A channel connects Galveston Harbor with the Gulf of Mexico and with the Gulf Intracoastal Waterway, which extends from Mexico to Florida.

Galveston is the home of the State Medical College



Browning, Pix

Sun, Surf, and Sand along Galveston's 32-mile-long beach front attract more than 1,000,000 visitors a year.

of the University of Texas, the John Sealy Hospital, the State Psychopathic Hospital, and the State Crippled Children's Hospital. It has three federal hospitals and Moody Memorial Home for cerebral palsy victims.

Spanish surveyors named the island for Count Bernardo de Gálvez, Viceroy of Mexico, in 1785. In 1836, the site of the city was bought from the Republic of Texas by Michael B. Menard, who organized the Galveston City Company. Galveston received its city charter in 1839. In 1900, a disastrous hurricane struck the island, killing about 6,000 people. It was the worst recorded disaster in the history of North America. The city built a huge wall of steel, concrete, and granite to guard against future hurricane damage. Galveston originated the commission form of government in 1901, but changed to the city manager form in 1961 (see CITY AND LOCAL GOVERNMENTS).

H. BAILEY CARROLL

GAMA, VASCO DA. See DA GAMA, VASCO.

GAMALIEL

GAMALIEL, *guh MAY lih ul*, a great Jewish scholar, was the rabbi, or teacher, with whom Paul studied in his youth. He was a member of the Sanhedrin, the high council of Jews in Jerusalem. The name *Gamaliel* comes from the Hebrew and means *reward of God*. Gamaliel was one of the Pharisees, and is said to have been president of the Sanhedrin for several years. He persuaded his associates not to kill Peter and the other Apostles for preaching Christian doctrines (Acts 5:34). He said that if Peter's teaching came from man alone, it would have no effect. If it came from God, there was no use fighting it. Some believed that Gamaliel became a Christian, but there is no proof to show that such a conversion occurred.

FREDERICK C. GRANT

See also PHARISEE; SANHEDRIN.

GAMBETTA, LÉON. See FRANCO-PRUSSIAN WAR (The End of the War).

GAMBIA, *GAM bih uh*, is a British colony and protectorate on the west coast of Africa. The protectorate has an area of 3,974 square miles. The colony covers 29 square miles within the protectorate. Gambia lies along the Gambia River. Ships can sail inland for 175 miles. For location, see AFRICA (color map).

Since the malaria-carrying mosquito has been almost wiped out, the climate is fairly healthful. Hippopotamuses and crocodiles live in the rivers and creeks. Lions, leopards, monkeys, wild boars, and deer abound in the forests and on the plains.

Gambia has a population of 279,686. The few Europeans in Gambia live on St. Mary's Island. Rice, maize (corn), cotton, groundnuts for making margarine, rubber, and palm oil are produced. The main exports are hides, beeswax, groundnuts, and palm kernels. Bathurst, the capital, is on St. Mary's Island (see BATHURST).

ALAN P. MERRIAM

GAMBIA RIVER is a stream in western Africa that rises in the Senegal mountains and flows westward for about 500 miles to the Atlantic Ocean. The western part of the river flows through the British protectorate of Gambia. The seaport of Bathurst, one of the most western points on the continent of Africa, lies at the mouth of the river.

LOYAL DURAND, JR.

GAMBIER, GAM beer, ISLANDS lie in the southeast Pacific, 900 miles southeast of Tahiti. The largest island of the group, called Mangareva, is a grass-covered ridge 5 nautical miles long and 1,447 feet high. A barrier reef and smaller, rocky islets enclose this island. Only three of these islets are inhabited. Sandy islets also lie on the barrier reef, which is 40 miles around. The land area totals about six square miles. The 510 Polynesian inhabitants of the islands raise chickens, pigs, goats, and food crops for their own needs.

Captain Henry Wilson, an English mariner, discovered the Gambier Islands in 1797. France claimed the islands in 1844, and later annexed them in 1881, to form part of French Oceania.

EDWIN H. BRYAN, JR.

GAMBLING means staking something of value in a game of chance. True games of chance require no skill. The outcome depends entirely on luck.

People gamble because they hope to win something for nothing. But one can more easily lose, and the loss may involve money which was earned by hard effort and which may be difficult to replace. A serious loss

often causes hardship. Hence it is not considered desirable or wise for anyone to gamble.

Gambling is as old as history. Dice games are known to have been popular in ancient times. The Roman historian, Tacitus, who lived about A.D. 100, stated that gambling was very common among the tribes of Germany. Some of the players would even stake their lives on the outcome of a game.

Gambling often means different things to different persons at different times. The laws of the various states of the United States have differing interpretations of what types of activities should be considered gambling. For example, insuring boats and their cargoes was once considered gambling. Authorities said that the insurance was really a wager on the outcome of an uncertain event. Most of the games played at amusement parks, carnivals, and county fairs are forms of gambling. The winner of many types of games receives a prize.

Legal Gambling. Many countries now prohibit professional gambling houses. But some permit certain games of chance, such as poker, that require some skill. A number of Latin-American countries permit the *lottery*, or the placing of bets on numbers drawn from a box. Many European countries allow casinos or gambling houses, where *roulette* and *rouge et noir* are popular.

The United States has no federal law against gambling houses, but Nevada is the only state that allows them. All other states have gambling laws of some kind. These laws permit some types of gambling, and forbid others. Some states tax the forms of gambling they allow and receive revenue in this way.

Social scientists have found that gambling laws do not stop gambling from taking place. For example, horse racing is legal in many states. This means that persons may bet on horse races if they do their betting at the race track. A certain percentage of the money wagered goes into the state treasury. But betting on horses is illegal away from the track. This does not prevent people from betting on horses. They seek out *bookmakers*, who take bets and pay off winners just as the race track does.

Other Forms of Gambling take place either within or outside the law. Bookmakers also take bets on prize fights, elections, and athletic contests such as basketball and football games. Dice are used in other games such as twenty-six and chuck-a-luck. Many persons gamble on *numbers games*, or *policy games*. The policy game is a form of lottery. A person takes any three-digit number from 000 to 999. There is a winning number for each day. Slot machines, punchboards, pinball machines, raffles, and bingo also account for much gambling in the United States.

JEROME S. MEYER

Related Articles in WORLD BOOK include:

Bucket Shop	Las Vegas	Monte Carlo	Roulette
Dice	Lottery	Poker	Wager

GAMBOGE, *gam BOHJ*, is a gumlike resin which is obtained from the gamboge tree. This tree grows in Cambodia, Ceylon, Thailand, and other countries of eastern Asia. See RESIN.

The juice which makes gamboge is found in the middle layers of the bark. After it is taken from the tree, the juice hardens and becomes a bright yellow color on the inside and a dirty orange color on the outside. Gamboge is used for mixing water colors, and for staining wood.

C. L. MANTELL



Fish and Wildlife Service

A Large Game Refuge in Nevada protects the almost extinct antelope that once used to roam the plains in great numbers. Female antelopes and their young live apart from the males

during the summer months. The females defend themselves with their sharp hoofs. Striking with their forefeet, they can disable a wolf or even cut a rattlesnake to pieces.

GAME is the name given to all wild animals that are killed by hunters for food, fur, or the sport of hunting. Game includes all kinds of animals—fierce beasts such as tigers and bears, small creatures such as rabbits and squirrels, and game birds such as ducks and geese.

Game Laws. The governments of most civilized countries have passed game laws in order to prevent too much killing of wildlife and the destruction of whole kinds, or *species*, of animals. In the United States and Canada, these laws forbid the shooting of animals except during certain periods each year. The period when game may be killed in limited quantities is known as the *open season*. The period during which killing is prohibited is called the *closed season*. Game laws limit the number of animals that each hunter may kill, or have in his possession, or ship out of the state.

Public Wildlife Refuges have been set aside for the preservation of wild animals by national, state, and provincial governments. In addition, the national parks are wildlife sanctuaries for thousands of wild animals. The largest game refuge on the North American continent is Jasper National Park in Alberta, Canada. It covers about 4,200 square miles. The largest in the United States is Yellowstone National Park (3,472 square miles). The U.S. Fish and Wildlife Service directs the nation's game-conservation program.

Private Game Preserves. On private game preserves, game may be hunted only by the owner. Some large areas in Europe have been private game preserves since the Middle Ages, when hunting was the privilege of the rich lords. Thousands of shepherds and farmers were driven off the land by wealthy landowners in Great Britain during the late 1700's, so that huge private game preserves could be established. At one time there were severe penalties for *poaching*, or hunting in a private preserve without permission. Today there are still many private preserves in Great Britain and elsewhere in Europe. They are less common in the United States and Canada. Other private game preserves are kept up by lovers of wildlife who wish to save the animals from the hunters. Many private conservation groups also donate funds for public refuges.

HERBERT E. KAHLER

Related Articles. See the articles AFRICA, ASIA, NORTH AMERICA, and SOUTH AMERICA for Animal Life maps. See also the Natural Resources sections of the various country, province, and state articles, such as ALABAMA (Natural Resources). See also the following articles:

PUBLIC WILDLIFE REFUGES

National Forest National Park Okefenokee Swamp

SOME GAME ANIMALS

See ANIMAL; BIRD; FISH, with their lists of Related Articles. See also:

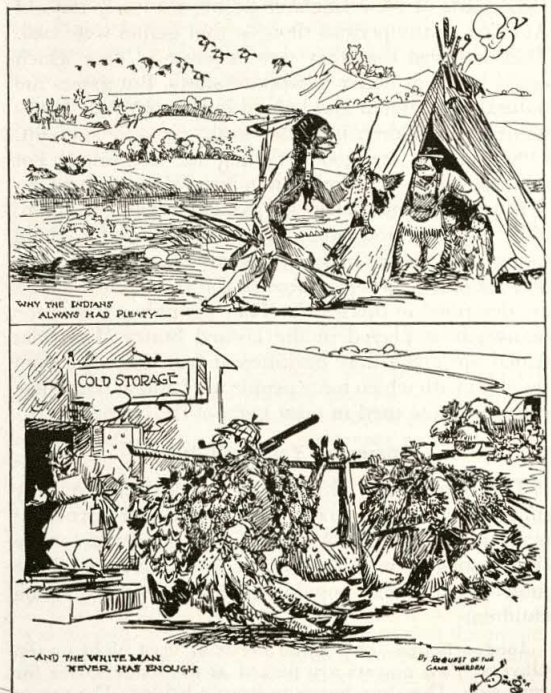
Bear	Elk	Mountain Lion	Tarpon
Buffalo	Hippopotamus	Rhinoceros	Tiger
Deer	Lion	Salmon	Trout
Elephant	Moose	Sturgeon	Walrus

UNCLASSIFIED

Angling	Fur
Big Game	Hunting
Conservation (Wildlife)	Trapping
Fishing	Wildlife Conservation

"Why Game Wardens Go Crazy," a cartoon by "Ding" Darling. This illustration shows that the Indians killed only for food, but that "civilized" white men kill much more than they can use. To protect our wild game, laws govern the number of animals that can be killed by a hunter during the season.

N.Y. Herald Tribune and Des Moines Register





Suzanne Szasz

The Mulberry Bush Is a Group Game for young children. The boy in the center must try to break through the circle.

the players get in line and march under the bridge to the tune of a song:

London bridge is falling down, falling down,
falling down.

London bridge is falling down, my fair lady.

At the last word of the song, the players who form the bridge lower their arms to catch the player who is passing under their arms at that time. They sing:

Off to prison you must go, you must go, you must go.
Off to prison you must go, my fair lady.

The player who has been caught then picks one of the leaders to follow. The rest of the players start in all over again to march under the bridge. The action is repeated until all players have been caught. The side which has the most players at the end wins the game.

Drop the Handkerchief. This game also needs a fairly large number of players. They join hands in a circle. One player is "It" and runs around the circle with a handkerchief. He drops the handkerchief behind one of the players. He keeps on running around and tries to get back to tag the player behind whom he has dropped the handkerchief, before that player can pick it up. If the player picks up the handkerchief first, he starts running to tag the one who dropped it. If the player who dropped it reaches the spot without being tagged, then the second player becomes "It." If the first player is tagged, he keeps on being "It." The song often sung with this game is "Itisket, Itasket."

Follow the Leader. This game can be played by any number of children. It can be played indoors or outdoors. The players get in line with the "leader" at the head of the line. The leader starts off and the rest follow him. They must go wherever he goes, and make any motions which he makes.

I Saw. This is a good game for indoors. One player tells of some action he has seen. He can say, "I saw a dog running," or "I saw a bird flying." The rest of the players then imitate the action which has been spoken of.

Farmer in the Dell. This is a singing game. All the players join hands in a circle, except one, the "farmer." He stands in the center of the circle. The players begin to sing:

The farmer in the dell, the farmer in the dell.

Hi ho, the derry oh, the farmer in the dell.

The farmer takes a wife, the farmer takes a wife.

Hi ho, the derry oh, the farmer takes a wife.

At this time, the "farmer" picks another player as his "wife." The "wife" then joins him inside the circle. The song continues with slightly different words in each verse. The "wife takes a child," the "child takes a nurse," the "nurse takes a dog." Then the "dog takes a cat," the "cat takes a rat," and the "rat takes a cheese." The game ends with:

The cheese stands alone, the cheese stands alone,

Hi ho, the derry oh, the cheese stands alone.

The game can start over again with the "cheese" becoming the "farmer" of the new game.

Cat and Mouse. This is a very good tag game. The players join hands in a circle. Two players are picked to be "cat" and "mouse." The cat stands outside the circle and the mouse inside. The cat tries to catch the mouse. The rest of the players help or hinder the cat by raising or lowering their arms. The cat and mouse can run in and out of the circle under the other players' arms. When the mouse is caught, other players are picked.

The Mulberry Bush. Again, all the players join hands in a circle. One player is chosen "It" and gets in the middle of the circle. The other players move around him and sing:

Here we go round the mulberry bush, the mulberry bush, the mulberry bush.

GAME. The games of children do not change much through the years. Roman children played a form of hopscotch. The rhymes of such games as "London Bridge" and "Farmer in the Dell" are over a hundred years old. Children today use the same words and play the games in the same way and with as much enjoyment as their grandparents did. Children's games are also much the same the world over. Chinese children play a form of tag. French children play a game much like "Here We Go Round the Mulberry Bush" to the words of a song called "On the Bridge at Avignon."

The only important changes which are made in most games come as the result of new inventions and new happenings. A game called "Train" was popular in the early 1900's. Children sat in seats in a line, and a conductor took up tickets. Nowadays children play much the same game. But they call it "Airplane," and instead of a conductor they have a stewardess.

One of the most pleasant things about games is that they are at the same time fun and good for people. In some parts of New England during the early days of America, many persons thought that games were bad. They believed that they were a waste of time which could be spent better in work or study. But games are natural for children and helpful in their growth. Many games get children into the fresh air and sunlight. Other games are good training for the mind. For adults, games are a relaxation from their daily work.

Kinds of Games. There are games for young children, older children, and adults. There are games for school rooms and playgrounds. There are games for parties and for family groups. Some of the best-known games are described in this article. They are only a few of the many games played in the United States. The rules which are given may be different in some ways from the rules with which some people are familiar. But these rules are those used in most parts of the country.

Games for Young Children

The group games which young children play are very simple. They usually have one action which is repeated over and over again. Many games are played with a simple song or repeated rhyme. Here are some of the most familiar and popular games played by young children:

London Bridge. This game needs at least eight or ten players. Two players are picked as the leaders, one for each side. They join hands to form a bridge. The rest of

Here we go round the mulberry bush, so early in the morning.

The player who is "It" runs against the arms of the other players as hard as he can and tries to break through the circle. If he breaks through, another player becomes "It."

There are many other games for young children. Many are much like these. The ones given above are the most familiar children's games. They have been played for hundreds of years in many different countries, and still are popular.

Games for Older Children

As children grow older, they change their games. They are not satisfied with just moving around, and they begin to think the songs and rhymes of the younger children are silly. The most noticeable change in their games is the beginning of competition. The older child likes games in which he himself can win. He also likes games in which the players "choose up sides." Here are some of the most common games of older children:

Hide and Go Seek. This game needs at least four or five players. One player is named "It." A tree or stone or some other object is picked as a "base." The player who is "It" covers his eyes at the base, and counts up to a hundred. As he counts, the other players go and hide. When he finishes counting, he begins to hunt for the other players. They may stay in hiding, or they may try to sneak back to the base. If they can sneak back, they are said to have come in "free." If the player who is "It" finds another player, they race back to base. If the player who has been found does not win the race, he becomes "It" and the game starts over again.

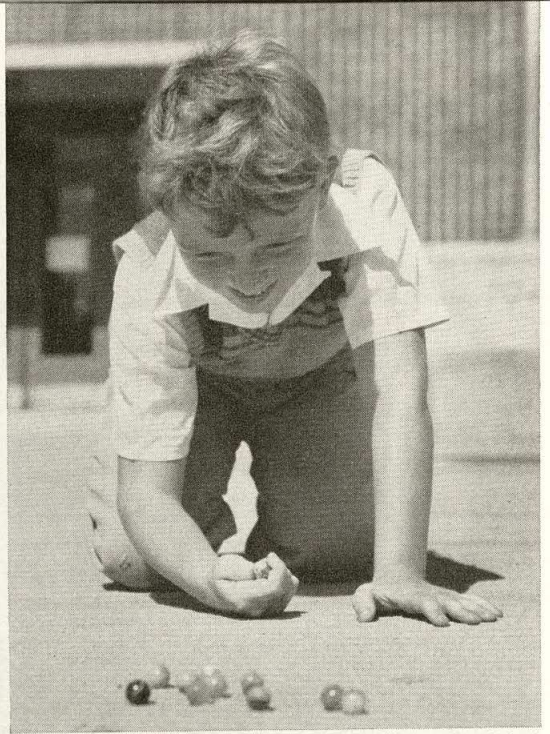
Run, Sheep, Run. This game is much like "Hide and Go Seek" except that it is played with two sides. One side stays at the base while the other side goes to hide. When they have hidden, their leader returns to a spot near the base. While one side hunts the other side, the leader of the group in hiding warns his side with signals. If the side in hiding is found or is in danger of being found, or if the side which is hunting gets far enough away from the base, the leader shouts, "Run, sheep, run." Then both sides race back to the base. Whichever side gets all its players there first, wins the game.

Tug of War. The players are divided into two equal sides. They line up on each side of a line marked on the ground, and take hold of a long, strong rope. Each side tries to pull the other side over the line. Whichever side is pulled over the line loses the game.

These are only three of the many common games of older children. Besides these, there are many kinds of

Tug of War is an Outdoor Game, played by teams pulling at opposite ends of a rope. The object of the tug of war is to pull the opposing team beyond a certain line or marker.

H. Armstrong Roberts



H. Armstrong Roberts

A Boy Playing Marbles is one of the surest signs of spring, since this outdoor game is seldom played at other seasons. Marbles is one of the oldest games of skill, and was played by the children of ancient Egypt and Greece.

tag games. Other well-known games for large groups are "Fire on the Mountain," "Three Deep," "Prisoner's Base," "Fox and Geese," "Leap Frog," and "Crack the Whip." All these are best played out of doors.

Older children enjoy races of all kinds. Such races as the "Overhead Race" can be played in schoolrooms. In the "Overhead Race," two sides race to pass a group of objects over each player's head down a line. Races are also popular at picnics. Some of the best-known races are relay races, the "Sack Race," the "Three-Legged Race," and the "Egg and Spoon Race."

Party Games are children's games usually played only at parties. They are group games and can be played indoors. Some of these are:

Blind Man's Buff. One of the players is blindfolded with a handkerchief. The other players stand very quietly about the room. They are not allowed to move. The blindfolded player tries to find one of the other players. He touches a player whom he finds, and guesses who he is. If he guesses right, that player becomes "It" and is blindfolded.

Hot or Cold. One player is named "It" and leaves the room. While he is gone, an object is hidden in the room by the other players. The player who is "It" then returns to the room. He tries to find the object and is guided by the other players. They tell him whether he is near or far from the object by saying he is "cold" or "hot," "warm" or "cool."

Going To Jerusalem or Musical Chairs. This game needs a piano and one less chair than there are players. The chairs are placed in two rows, back to back. The players form a chain around the chairs. When the piano starts to play, the players march around the chairs. The music stops suddenly. When it stops, everyone tries to sit down in a chair. The player who does not get a chair has to leave the game. One chair is taken away and the music starts again. The game is repeated until there is only one chair left. The player who succeeds in sitting down in it wins the game.



Harold M. Lambert

Skipping Rope during a School Recess. This is one of the most widespread forms of outdoor recreation for girls of elemen-

tary school age. There are many forms of rope-skipping, some of which require considerable skill and endurance.

Games of Skill. Some of the best children's games are games of skill. They are usually played with only two or three players and require some equipment. Boys play many kinds of games with marbles. "Jacks" are more popular with girls and require a great deal of skill with the hands. "Hopscotch" is a favorite game for girls and is good training in balance. "Tiddleywinks" develops skill in eye and muscle co-ordination. There are many games and contests which require skill in aiming or throwing, such as "Darts" and "Ringtoss." Skipping rope is more an exercise, but many children turn it into a competitive contest.

Games for Young People and Adults

At about the time young people enter high school, they lose interest in the games of their childhood. Most of the children's games begin to seem childish, and high school students prefer games which require greater mental and physical skill. At about this age, people also begin to show individual taste in games. The games of children are popular with all children. The games of young people and adults are popular only with groups of young people and adults. Some persons like sports which give them a lot of exercise. Other persons prefer games which make them think. Almost all these games are competitive.

Most games for older persons require some equipment. This may be as simple as a pair of dice or a pack of playing cards. Or the equipment may be as complicated and expensive as an ivory chess set. In recent years, the manufacture of game equipment has become a large industry in the United States and Europe. Some new games have become extremely popular.

Board Games. Some of the most popular games are played on boards which are marked off in squares or other kinds of divisions. Probably the oldest of all such games is chess. A form of chess has been played in China for more than three thousand years. It has been played in Europe for over a thousand years. It is one of the most difficult of all games to master. Another popular board game is checkers. Checkers is easier than chess, and children enjoy the game. A backgammon board is often

Partners in a Table Tennis Doubles Match. Table tennis is one of the most popular indoor games of skill in America, and can be played by either two or four players. In a doubles game, as shown here, partners alternate in returning shots.

H. Armstrong Roberts





DURAND SEAR

Checkers, a Game First Played Thousands of Years Ago, Is Still a Favorite of Young and Old.

found on the back of checkerboards. Backgammon is played with dice and checkers.

Many of the most popular games invented by game manufacturers are board games. Many of them are variations of old games of "Parcheesi," "Lotto," and "Monopoly." "Scrabble" combines the equipment of board games with the idea of *anagrams*, or making words by changing or adding letters. Two to four players spell words, building on the first player's combination. Board games are also popular among younger children. Such games usually combine competition, luck, and skill, and are designed to appeal to specific age groups.

Card Games. Playing cards are as old as the history of civilized man. More games can be played with cards than with any other kind of equipment. Cards make it possible to play *solitaire*, one of the few games which can be played by one person only. There are card games played with many different kinds of cards. Many of these are for children. Some of the best known of these are "Rook," "Authors," and "Old Maid."

Parlor Games. There are many games played by young people and adults at parties, which have come to be known as "parlor games." These games are usually tests of knowledge, memory, and quick mental reaction. Some of the best known of these are:

Charades. There are various forms of this old game. The main idea of the game is for a player or group of players to act out a word or phrase. The other players try to guess what is being acted. This game is played

at parties by both children and adults.

Twenty Questions. There are also several varieties of this guessing game. Sometimes it is called "Animal, Vegetable, or Mineral," and sometimes "Who Am I?" A player usually selects an object or a person. One or more players then try to guess this object or person by asking questions which can be answered by "yes" or "no." Usually the number of questions is limited.

Categories. This game is a test of a person's knowledge and memory. It is played with pencil and paper. A number of kinds of things are picked, such as poets, automobiles, or countries. Then a key word is picked, such as "worthy." Each player tries to name a poet, an automobile, and a country, whose names begin with each of the letters of the key word. A player scores a point for each correct name he puts down. The player with the most points wins the game.

BERNARD S. MASON

Related Articles in WORLD BOOK include:

GAMES

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GAME FISHING

GAME FISHING. See FISHING.

GAME OF CHANCE. See GAMBLING.

GAMELANG. See INDONESIA (The Arts).

GAMETE. See REPRODUCTION (Plant); ALGAE.

GAMETOPHYTE, *guh ME toe fite*, is a phase in the life cycle of certain plants. Some plants pass through two phases. In one phase, they reproduce by means of spores. In the other, the *gametophyte* phase, they reproduce by means of eggs and sperms. See also REPRODUCTION (Plant).

GAMMA GLOBULIN is one of several groups of proteins present in blood *plasma*, the liquid part of the blood. The amount of gamma globulin present in the blood is not constant. When an infection begins, special tissues in the body manufacture antibodies to fight it. These antibodies are chiefly gamma globulins.

Scientists became interested in the relationship between antibody production and gamma globulin. They found that when the amount of gamma globulin decreases, a person's resistance to infectious diseases is lowered. Doctors sometimes give gamma globulin to protect a person from infectious diseases. They often give it to increase resistance to measles. Doctors also sometimes give gamma globulin to build up resistance to chicken pox. But, once a person has the disease, gamma globulin is ineffective.

WILLIAM DAMESTIK

See also ANTIBODY; GLOBULIN.

GAMMA RAY is an electromagnetic radiation of the same character as an X ray, but it has a much shorter wave length. X rays were first produced by Wilhelm K. Roentgen in 1895, but scientists did not discover until some years later that radioactive elements give off penetrating gamma rays.

Members of the uranium-radium series of radioactive elements give off gamma rays when they disintegrate to form new elements. When a nucleus emits a gamma ray it remains unchanged—all that happens is that it loses a certain amount of energy. But it gives off a very penetrating ray if it loses a very large amount of energy, say, 5 million electron volts (Mev). A sheet of iron about 1 inch thick will stop 50 per cent of gamma rays of this energy. But it takes about 9 inches of water to equal the absorbing ability of 1 inch of iron. A heavy element such as lead is very good for stopping gamma rays. About half an inch of lead equals 1 inch of iron in absorbing power.

Gamma rays lose energy by colliding with atoms in passing through water, air, lead, iron, or any other material. In these collisions, gamma rays may knock electrons loose from their parent atoms. This process is called *ionization*, because it changes the previously neutral atom into a charged particle called an *ion*. High-energy gamma rays may create matter by completely disappearing and forming a pair of electrons, one a positively charged *positron* and one a negatively charged ordinary electron, or *negatron*. This creative process is the opposite of what occurs when the particle called a positron dies or is destroyed to form two gamma rays.

When gamma rays pass through the body, they produce ionization in tissue. If too many gamma rays bombard the tissue this may prove harmful to the cells. Extremely small amounts of gamma rays bombard us every day from the natural radioactivity of the chairs

we sit upon, the water we drink, and the air we breathe. Only large amounts of gamma radiation are dangerous. See RADIATION.

Although gamma rays in large amounts may be harmful to the body, they can also be of great benefit. They may be used to treat some cancers, tumors, and skin afflictions. With X-ray machines, medical men use gamma rays to examine the body for broken bones or foreign objects, and for signs of diseases such as tuberculosis. Sources of strong gamma rays, such as radium and radiocobalt, may be used to X-ray iron castings for flaws. Penetrating gamma rays from a betatron may be used to inspect thick metal for flaws or cracks. Scientists have used gamma rays experimentally to preserve food and to vulcanize rubber.

RAEHL E. LAPP

Related Articles in WORLD BOOK include:

Atomic Energy	Light (color picture;	Radioactivity
Betatron	Uses of Electro-	Radium
Electron	magnetic Waves)	X Rays

GAMOW, *GAY mahv*, or *GAY mow*, **GEORGE** (1904-), a nuclear physicist, author, and teacher, became known for his theories of radioactivity and of the origin and evolution of the stars, planets, and sun. He believed that changes in atomic nuclei explain the origins of the solar system and the universe.

Born on March 4, 1904, in Odessa, Russia, Gamow was graduated from the University of Leningrad. He spent several years in teaching and research at European universities. He became a professor of physics at the University of Colorado in 1956. A United States citizen after 1940, he served as a consultant to the armed forces during World War II. His books include *The Birth of the Sun* (1940), *Biography of the Earth* (1941), and *One, Two, Three . . . Infinity* (1947).

R. T. FELLICKSON

GAND. See GHENT.

GANDER AIRPORT is a famous international airport near the town of Gander in eastern Newfoundland. It is about 120 miles northwest of St. John's. The British government built Gander Airport in 1939, shortly before the outbreak of World War II. For location, see NEWFOUNDLAND (color map).

During the war, Gander Airport was the chief take-off point for the bombers and other aircraft sent from the United States and Canada for the offensive against Germany. After the war, the airport passed over to the



government of Newfoundland and was used for civilian purposes. When Newfoundland became a Canadian province in 1949, the airport became the property of the Canadian government.

Gander Airport now serves as the chief refueling point in North America for transatlantic aircraft of all types. In a normal year, 12,000 planes make use of Gander Airport. The planes carry more than 500,000 passengers to their various destinations.

The airport has three runways, the longest measuring 8,600 feet. Gander's terminal can handle 1,000,000 passengers a year. It is considered one of the best terminals in Canada.

A town has been developed about three miles from Gander Airport. The town has been carefully planned along modern lines. Gander has about 3,000 residents. It is connected with the rest of the province by rail and road. Near Gander is the famous Gander River, which is noted for its salmon fishery.

FRED W. ROWE

GANDHI, *GAHN dee*, **MOHANDAS KARAMCHAND** (1869-1948), was a spiritual and political leader of India. He worked successfully for India's freedom from British control, and promoted social and economic reforms in the country.

Gandhi was born in Porbandar of parents who belonged to the Vaisya, or merchant, caste (see **CASTE**). He studied law in London. After a short, unsuccessful legal career in India, he went to South Africa in 1893. He built a prosperous practice, but spent more and more time defending the rights of the Indian minority in South Africa. The South African government discriminated against his countrymen in voting, taxation, and holding property. In fighting these laws, Gandhi developed the idea of *Satyagraha*, or peaceful defiance of the government. His program was influenced by writings of the American author Henry David Thoreau (see **THOREAU**, **HENRY DAVID**). Gandhi led campaigns of civil disobedience, and had won some justice by the time he left South Africa.

Campaigns for Indian Independence. Gandhi returned to India in 1914 and cooperated with the British government during World War I. In 1919, however, he began his freedom movement. He accused the govern-

Gander Airport in eastern Newfoundland serves as the chief North American refueling point on transatlantic air routes.

Department of Transport, Ottawa



Schlesinger, Montreux, Switzerland

Mohandas K. Gandhi led a campaign of passive resistance to British rule. He sought political, social, and economic reforms.

ment of brutality in the Amritsar Massacre (see **INDIA** [India After World War II]). During the early 1920's, he began campaigns of nonviolent disobedience, to win independence. He was saddened that his followers sometimes turned to violence. Gandhi took control of the Congress party, which led the Indian nationalist movement. He worked closely in the party with Jawaharlal Nehru, who later became the first prime minister of India (see **NEHRU**).

During World War II, Gandhi demanded independence for India in return for his country's help against Japan. In 1942, he led another civil disobedience movement. Great Britain granted freedom to India in August, 1947, but rioting broke out between Hindus and Moslems. Gandhi called for peace and an end to bloodshed, but was shot to death on Jan. 30, 1948. His assassin was one of the Hindu fanatics who hated Gandhi for opposing what he considered excesses in the caste system.

His Way of Life. Gandhi was called the *Mahatma*, or "Great Soul." He lived simply, ate no meat, and wore only a loincloth. At the heart of his teaching was the power of love. Millions of Indians revere Gandhi as their kindly *Bapu*, or father.

The people of India built a shrine to Gandhi's memory in New Delhi.

T. WALTER WALLBANK

GANG refers to any informally organized group of persons. It usually applies to groups of men or boys who perform acts that are either against the law or on the borderline. Several kinds of gangs exist in the United States, especially in large cities. One kind consists of ex-criminals, criminals, and borderline racketeers who band together to carry out their illegal activities more effectively. The word *gangster* refers to a member of such a gang. The teen-age gang is another type. Most of these are essentially friendship groups that carry on secret activities for recreation. But the members of some gangs are juvenile delinquents. They fight, steal, and engage in other criminal activities. Some adult and teen-age gangs are linked together in organized rings, for the purpose of engaging in criminal activities. JOHN F. COOPER

GANGES RIVER

GANGES, GAN jeez, RIVER is the greatest waterway in India and one of the largest in the world. It is most important to the Indians for the part it plays in the Hindu religion (see **HINDUS**). Hindus consider it the most sacred river in India. Each year thousands of Hindu pilgrims visit such holy cities as Banaras and Allahabad along the banks of the Ganges to bathe in the river and to take home some of its water. Temples line the riverbank, and stairways, called *ghats*, lead down to the water. Some pilgrims come to bathe in the water only to cleanse and purify themselves. The sick and crippled come hoping that the touch of the water will cure their ailments. Others come to die in the river, for the Hindus believe that those who die in the Ganges will be carried away to Paradise.

The river is an important trade area. Its valley is fertile and densely populated. Some of India's largest cities—Calcutta, Howrah, Patna, Banaras, Allahabad, and Cawnpore are located on its banks. India's capital, New Delhi, is on one of its tributaries, the Jumna. But the Ganges is less important commercially than it once was. Irrigation has drained away much of its water and steamers now can navigate only in the lower part of the river.

The Ganges has its beginning in an ice cave 10,300 feet above sea level in the snow-covered Himalaya Mountains of northern India. The river flows toward the southeast and through East Pakistan for 1,540 miles to empty into the Bay of Bengal. Several tributary rivers, including the Jumna, Ramganga, Gumti, Gogra, Son, and Kusi add to the waters of the Ganges. The Brahmaputra River joins some of the branches of the Ganges near its mouth, and together the two rivers form

a large delta of jungle and swampland. For location, see **INDIA** (color map).

J. E. SPENCER

See also **BRAHMAPUTRA RIVER**.

GANGLION. See **NERVOUS SYSTEM** (Kinds of Nerves).

GANGRENE, GANG green, is the death of the tissues in a part of the body, such as a toe or foot. Death of this kind is called *mortification*. In *dry gangrene* the part turns black and loses all feeling. The healthy tissue near the gangrene shows a red inflamed zone, called the *zone of demarcation*. Theoretically, if the diseased part came off by itself, it would separate from the rest of the body just beyond this zone. *Moist gangrene* has the same symptoms as the dry kind, but in addition there may be blisters, oozing fluid, and disagreeable odors. Bacteria which cause the flesh to decay play an important part in moist gangrene, but not in dry.

Some of the causes of gangrene are diabetes, plugged arteries in old age, freezing and frostbite, bad wounds, and infections. Formerly, gangrene often followed infection of wounds. Certain hospitals were not often used for operations, because so many cases of "hospital gangrene" occurred in them. In World War II there were many cases of gangrene among aviators who were frost-bitten at high altitudes, and among men who were forced to stand in cold water for several days. *Raynaud's disease* is one of a small group of diseases that tend to cause dry gangrene.

PAUL R. CANNON

See also **RAYNAUD'S DISEASE**; **TOURNIQUET**.

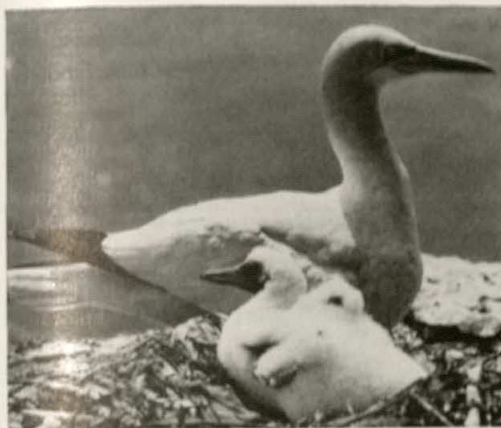
GANNET is a large white sea bird with black-tipped wings. It often helps fishermen because it follows schools of herring and other fish and thus shows where the fish are. The gannet dives from the air and plunges under the water for the fish.

Gannets have strong, sharp bills, webbed feet, and a small pouch beneath their throats. They grow to be



The Ganges River in India is sacred to all Hindus. Each year, millions of pilgrims bathe in the river to cleanse and purify themselves. Many Hindu temples line the riverbank, especially in such holy cities as Banaras and Allahabad.

Gopal, Black Star



H. Armstrong Roberts

The Gannet is a Large, White Sea Bird which looks somewhat like a goose. It has a strong, sharp bill.

about 3 feet long. They make their nests of seaweed on rocky cliffs on Bird Rock and Bonaventure in the Gulf of Saint Lawrence, and on islets off the British Isles. They are quite tame, and the mother will not move off her one pale, bluish-white egg when a person comes close to her. Some of the tropical relatives of the gannet are called *boobies*.

Scientific Classification. Gannets are members of the family *Sulidae*. They are classified as genus *Morus*, species *bassanus*.

ALEXANDER WETMORE

See also BOOBY.

GANNETT, HENRY (1846-1914), an American geographer and statistician, became known as "the father of American mapmaking." From 1882 until his death, he served as geographer of the United States Geological Survey. He was editor of the *National Conservation Commission* from 1903 to 1909. He helped found the National Geographic Society and the U.S. Board of Geographic Names.

Gannett was born at Bath, Me., and was graduated from Harvard University. He wrote *A Manual of Topographic Methods* (1893) and *Commercial Geography* (with others, 1905).

J. RUSSELL WHITAKER

GANNETT PEAK is the highest mountain in Wyoming. It lies in the west-central section of the state. It is 13,785 feet high.

GANNON COLLEGE is a private men's school at Erie, Pa. It is affiliated with the Roman Catholic Church. Gannon offers bachelor's degrees in liberal arts, electrical and mechanical engineering, and business administration. It has an ROTC unit. The college was founded in 1944 by the Most Rev. John M. Gannon, Bishop of Erie. For enrollment, see UNIVERSITIES AND COLLEGES (table).

WILFRIED J. NASH

GANYMEDE, *GAN th meed*, in Greek legend, was a beautiful youth, the son of Tros, King of Troy. Zeus spied Ganyমেদে on Mount Ida. Impressed with his beauty, Zeus swept him up and carried him off to Mount Olympus to succeed Hebe as cupbearer to the gods. Ganyমেদে became a favorite of the gods and was eternally young. See also *HEBE*.

Ganyমেদে Feeds the Eagle in a statue by Bertel Thorvaldsen. Zeus, king of the gods, took the form of an eagle and carried Ganyমেদে off to make him cupbearer for the gods.

GANZ, *gahnz*, **RUDOLPH** (1877-), is a Swiss-American pianist, composer, and conductor. For several years he toured Europe and the United States as a pianist, helping to popularize the works of many composers. As conductor of the St. Louis Symphony from 1921 to 1927, he introduced children's concerts. Ganz was born in Zurich, Switzerland. At 22, he made his debut as pianist with the Berlin Philharmonic Orchestra. In 1933, he became president of the Chicago Musical College, now part of Roosevelt University. **IRVING KOLOBY**

GAP is a narrow valley or gorge cut by a stream across a ridge. If the river still occupies a gap, it is a water gap. If the river abandons it, the gap becomes a wind gap. Railroads and highways follow many gaps. The best-known examples of both types occur in the Appalachian Mountains. Harpers Ferry Gap, cut through the Blue Ridge by the Potomac River, is a water gap. The historic Wilderness Road passed through Cumberland Gap, a typical wind gap in the Cumberland Mountains. See also CUMBERLAND GAP; DELAWARE WATER GAP.

SIGMUND DE R. DIETRICH

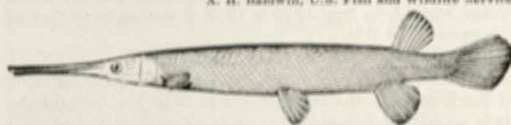
GAPES. See CHICKEN (Diseases).

G.A.R. See GRAND ARMY OF THE REPUBLIC.

GAR, *gahr*, is a fierce and greedy fresh-water fish of eastern North America. Gars usually live in lakes and large rivers. They are found in streams along the Atlantic Coast from Canada to Florida, and from Florida to Louisiana along the Gulf of Mexico. Gars also live in

The Longnose Gar Preys On Other Water Animals.

A. H. Baldwin, U.S. Fish and Wildlife Service



the waters of the Mississippi Valley, in the Great Lakes, and in Cuba and Nicaragua.

Gars have long, slender bodies with scales as hard as flint. They have beaks armed with large sharp teeth.

The *longnose gar*, or *billfish*, has extremely long and slender jaws. It grows to be about 5 feet long. The *shortnose gar* is usually 2 to 3 feet long. The heavy-set *alligator gar* is the giant of the tribe. It may grow to be

Thorvaldsens Museum, Copenhagen



GARAND RIFLE

15 feet long. This is the largest fresh-water fish of North America. Its flesh can be used for food, but is not commonly eaten.

The name *gar* is also applied to the marine *needlefishes*. They look like true gars, but have tiny soft scales.

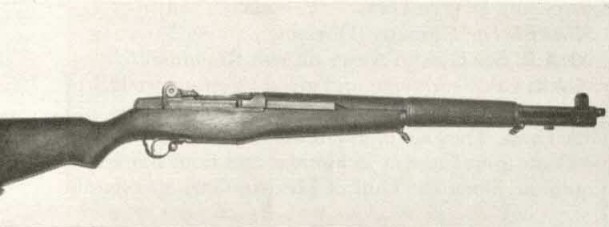
Scientific Classification. Gars are in the family *Lepisosteidae*. The longnose gar is genus *Lepisosteus*, species *osseus*; the shortnose, *L. platostomus*; and the alligator, *L. spatula*.

CARL L. HUBBS

See also FISHING (Game-Fishing World Records); PIKE.

GARAND RIFLE, also called *Rifle, U.S., caliber .30, M1*, is an eight-shot semiautomatic weapon. It was the basic rifle of the United States Marine Corps. The United States Army used the Garand rifle from 1936 to 1958, and then replaced it with the M14. The M1, in turn, had replaced the M1903. John C. Garand, a government designer, developed the M1 rifle in 1929.

The Garand rifle is gas-operated. The bullet uncovers a small hole before it leaves the barrel. Compressed



U.S. Army

The Garand, or M1, Rifle served as the official rifle of the United States Army from 1936 to 1958. It was replaced then by the newer M14 rifle.

gases behind the bullet rush through to a piston, driving it back against the operating rod. The rod rotates the bolt to unlock it, pushes it back to open the rifle, and helps eject the used cartridge. A recoil spring closes the bolt and rams a fresh cartridge into position to fire when the trigger is again pulled. The M1 fires one shot at each trigger pull.

The M14 works similarly, but has a box magazine of 20 shots. It also fires automatically, discharging 20 shots when its trigger is held down. MELVIN M. JOHNSON, JR.

See also CARBINE; CARTRIDGE; MACHINE GUN; RIFLE.

GARBAGE DISPOSAL is a method of getting rid of waste food from private homes, stores, and warehouses. The largest amount of garbage comes from private homes. The disposal of this waste food creates one of the big problems of modern life, especially in crowded towns and cities. Waste and rotting food attracts all kinds of insects, rodents, and bacteria, and is a great health menace if it is not removed. Disease-carrying flies lay their eggs in garbage, and rats feed on it.

Most city families put their garbage in large metal cans. These are placed in the alley or some other place where they can be emptied by the garbage collector. In some places, the city employs a garbage collector. In other communities, the garbage collector is a private contractor paid either by the city, or by each family whose garbage he collects. The garbage collector drives a truck or wagon around the community, and empties the garbage from the cans into his truck. Most cities

today regulate the disposal of garbage. Some have chemical treatment plants which convert garbage to fertilizer. Others use treated garbage to fill in land. The United States Public Health Service reports that there is from a quarter of a pound to about two and a quarter pounds of garbage a day for every person in the United States. Collecting it costs several dollars a ton.

Some farmers and persons who live in small towns feed their garbage to farm animals and poultry. One danger in this practice is that the larva of a parasite called *trichina* is found in pork. It can be killed by proper cooking. When hogs eat pork that has been improperly cooked, they become diseased, and their meat is dangerous to eat. See TRICHINA.

Many private homes have their own *incinerators* for burning garbage, so that it is not necessary for the garbage collector to come for it. But some cities prohibit burning because of the smoke. See INCINERATOR.

A small electric garbage grinder, or garbage disposal, may be installed in the sink. It turns the garbage into a liquid, which passes down to the regular sewage system. Some small cities in the United States have installed sink garbage disposals in private homes as a public service. The sink disposals eliminate the problems of garbage collection in these cities. R. G. HENNES

See also PUBLIC HEALTH SERVICE; SANITATION.

GARBO, GRETA (1906-), is a famous Swedish-American actress. Her biographer, John Bainbridge, described her as "the most-celebrated actress the screen has ever seen." She became well known for her dislike of publicity.

Miss Garbo, born GRETA GUSTAFSON in Stockholm, began her career as a dancer in Sweden. She won international fame in the Swedish motion picture, *Gösta Berling*. At 19, she went to Hollywood, where she starred in such successes as *Camille*, *Anna Christie*, and *Ninotchka*. Her profile, honey-colored hair, large blue eyes, and beautiful but mysterious smile, made her an ideal heroine. In 1941, at the peak of her success, Garbo gave up acting, without explaining why.

See also MOTION PICTURE (picture, Scenes from Famous Motion Pictures).

GARCÍA, *gahr THEE ah*, was the family name of four famous Spanish singers and teachers.

Manuel del Pópelo Vicente García (1775-1832) was a teacher, singer, and composer. He went to Paris as principal tenor at the Italian Theater. In 1825, he founded an Italian opera company in New York City, which included his son and elder daughter, Maria (see MALIBRAN, MARIA FELICITA). García also toured Canada and Mexico. He was born in Seville.

Manuel García (1805-1906), son of the elder Manuel, became a well-known singer, composer, and conductor by the time he was 20. After 1848, he taught singing in London and Paris. He invented the *laryngoscope*, an instrument for examining the larynx, and wrote about voice culture. He was born in Madrid.



MGM

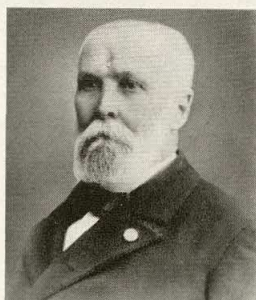
Greta Garbo

NARDI REEDER CAMPION

Pauline García (1821-1910), the younger daughter, was a brilliant mezzo-soprano. Her most successful role, which she is said to have sung 150 times, was Orpheus in Christoph W. Gluck's *Orfeo ed Euridice*. She was born in Paris.

SCOTT GOLDTHWAITE

GARCÍA Y ÍÑIGUEZ, *gahr SEE ah ee EE nyee gays*, **CALIXTO** (1839-1898), a Cuban lawyer and revolutionary general, commanded a Cuban army against Spain in the revolt of 1895 to 1898 which preceded the Spanish-American War. During the war, Lieutenant Andrew S. Rowan of the U.S. Army carried a message to García asking what aid the United States should send. This inspired Elbert Hubbard's essay, "A Message to García." García was born at Holguín, and died while in Washington, D.C. HARVEY L. JOHNSON



Brown Bros.

Calixto García

GARCÍA LORCA, FEDERICO. See LORCA, FEDERICO GARCÍA.

GARCÍA-SARMIENTO, FÉLIX RUBÉN. See DARÍO, RUBÉN.

GARDA, LAKE. See LAKE GARDA.

GARDEN, MARY (1877-), an American soprano, was considered one of the finest singing actresses of her time.



Brown Bros.

Mary Garden

While studying in Paris in 1900, she was the understudy for the leading role in Gustave Charpentier's *Louise*. When the star became ill on opening night, Miss Garden sang the part and scored a great personal triumph. Later, she created the role of Mélisande in Claude Debussy's opera, *Pelléas et Mélisande*. Opera lovers remember her for roles in such operas as Jules Massenet's *The Juggler of Notre Dame*, Italo Montemezzi's *The Love of Three Kings*, and Henri Février's *Monna Vanna*. She retired at the height of her career. Miss Garden was born in Aberdeen, Scotland, and came to America at an early age. She studied voice in Chicago and later joined the Chicago Civic Opera Company. MARTIAL SINGHER

GARDEN CLUB OF AMERICA provides a means of exchanging knowledge and experience in gardening and related fields. Garden clubs seek to stimulate a knowledge and love of growing plants of all types. They encourage good gardening through scholarships, awards, lectures, and exhibits. Most clubs cooperate closely with local school boards. Garden clubs are also leaders in the field of conservation. They work through schools and youth groups to teach the methods and value of preserving plants, wildlife, and natural resources. The club's national headquarters are at 15 East 58th St., New York 22, N.Y. MARY H. HARRISON

See also FLOWER (Flower Displays).

GARDEN OF CANADA. See ONTARIO.

GARDEN OF EDEN. See EDEN.

GARDEN OF THE GODS is a scenic park located near Colorado Springs, Colo. The park covers an area of more than 700 acres at the eastern base of the Rocky Mountains. It is a region of huge red and white sandstone rock masses that rise in strange shapes. Every year thousands of tourists visit the Garden. Its sunrise church services on Easter Sunday are famous. The heirs of Charles W. Perkins of Burlington, Iowa, gave the eastern half of the park to Colorado Springs. The city purchased the western half in 1932. The best known of the hundreds of rocks in the Garden include the *Cathedral Spires*, *Balanced Rock*, *Siamese Twins*, and *Indian Head*. These formations were created by an upheaval of the rock strata to an almost vertical position. This upheaval was followed by thousands of years of erosion by wind, rain, and frost. ELDRED D. WILSON

See also COLORADO (color picture).

GARDEN OF THE GULF. See PRINCE EDWARD ISLAND.

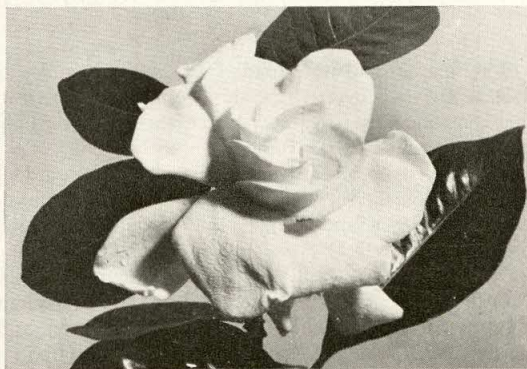
GARDEN STATE. See NEW JERSEY.

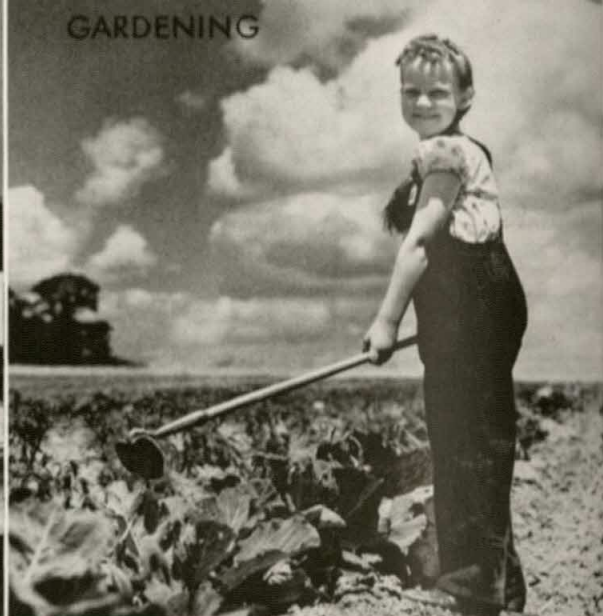
GARDENIA, *gahr DEE nih uh*, is a shrub or small tree that bears a fragrant, waxy, white flower. Botanists classify the gardenia with plants of the madder family, which includes the coffee and quinine trees. The gardenia shrub is native to the tropics and subtropics. It is very sensitive to temperature. The leaves become yellow and unhealthy at temperatures below 60°F. The flower buds form best at temperatures between 60° and 62°F. A moist atmosphere is also desirable. Therefore, gardenias are difficult to grow and are usually raised in greenhouses or conservatories, where temperatures can be controlled.

The beautiful gardenia blossoms are double. The varieties used for corsages are Belmont, Hadley, and McLellans 23. The gardenia is often called *Cape jasmine* because it smells like jasmine and was first brought to England from the Cape Colony in Africa. A small-flowered form of gardenia, called *veitchi*, grows as a potted plant.

Scientific Classification. The gardenia belongs to the madder family, *Rubiaceae*. It is genus *Gardenia*, species *jasminoides*. GEORGE A. BEACH

The Gardenia was named in honor of Alexander Garden, a Scottish naturalist who collected botanical specimens in South Carolina before the Revolutionary War in America. Mattie Edwards Hewitt





H. Armstrong Roberts

GARDENING. People of all ages in every part of the world grow food and flowers in gardens. Gardening for some persons is a pleasant recreation, to others an absorbing hobby. To millions it is the work by which they make their own daily bread and help to feed the rest of the world.

One of the best things about home gardening is that it can be enjoyed by anyone who loves nature and who has a few square feet of soil in which to work. From the time children can first toddle after their mothers, helping to pull weeds and plant seeds, gardening can be exciting and interesting for them all their lives.

Gardening makes a person appreciate beauty, and gives a realization that plants, like all other living things, will be well and healthy only if they are given good care, proper food, and enough water and sunshine. Anyone who plants a garden must "follow through" if he wants success. A week's neglect of weed pulling or of watering in a dry spell may result in a ruined garden. Plants are living things and they deserve good care on the part of the gardeners.

The families who live on most small or medium-sized places are able and glad to do all the gardening themselves. Sometimes an expert or a landscape architect is called in to make the first plans. Perhaps he plants the trees, shrubs, and hedges, and lays out the driveways.

Kinds of Gardens

The first gardens were made by primitive peoples as soon as they discovered that they could settle down in one spot and bring in the wild roots and other edible plants to grow near their homes.

The next type of garden was the medicinal garden, where healing herbs were grown by priests and physicians. The Greeks and Romans had gardens where such useful plants grew.

Irrigation or artificial watering of gardens began in countries like Egypt where there is little rain. In ancient Egypt vegetables, grain, fruits, herbs, flowers, and various trees, were grown in the temple gardens and on great estates.

Persons of Every Age Can Enjoy Gardening. Cultivating plants can be a life's work or a healthful, relaxing hobby.

Gardening has been highly developed since very ancient times. The Hanging Gardens of Babylon were one of the Seven Wonders of the World. Nebuchadnezzar built them for his wife about 600 B.C. because she missed her homeland of hills and trees. Terraced gardens were also built in Assyria. The formally planted courtyard and the plantation of trees—called an *arboretum*—came originally from Persia. See ARBORETUM.

Groves of sacred trees were planted in China many centuries before Christ was born. Chinese gardens reached their highest development about A.D. 1370.

Pot gardening was first carried on in Greece as a part of the worship of Adonis, the god of green growing things. The science of botany also developed in Greece. Roof gardens came to us from ancient Rome. In Rome too, practically every citizen had his vegetable patch, where he grew cabbage, root crops, and asparagus.

During the Middle Ages in Europe, most of the gardens were in the monasteries. Fruits, vegetables, and medicinal herbs were grown. During the Renaissance, gardening made great progress throughout Europe. Flowers, herbs, clipped trees, lawns, hedges, and fruits were formally planted. Fountains, statues, and pools were added to lend interest. The garden movement started strongly in Italy. Country villas were beautified by rectangular gardens enclosed by clipped hedges, decorated with statuary, and crossed by babbling streams. In France, formal terraces and planted beds stretched before the country houses in regular designs. Spain originated the patio, or planted courtyard, which was developed into typical Spanish gardens.

In England all these influences joined to produce the great formal English gardens of the 1600's. These often covered as much as thirty acres of ground. These gardens usually had terraces, "covered walks" of trees with branches interlaced overhead, and tiled walks. Summer houses, statuary, clipped shrubs, and formal flower beds were found in many of these formal gardens.

In the United States all these types of gardens have

been used. Many different kinds of gardens are found in America today.

Sun-loving rock plants are planted in rock gardens and on walls. Patio gardens are especially popular in California and other hot parts of the country. Courtyards are planted with trees and shrubs and decorated with pot plants to make a pleasant setting for outdoor living. Roof gardens decorate city homes. They are planned and planted rather like patios. Water gardens have pools, streams, water lilies, and moisture-loving flowers. Large estates have formal gardens where flowers and shrubs, planted in borders and beds with mathematical exactness, are laid out to give long views, or vistas. In informal gardens flowers and shrubs display their riot of color in gay, casual borders. These borders are often designed in long, free curves which may follow the boundaries of the property.

Kinds of Garden Plants

The plants important in gardening fall into four main classes: trees, shrubs, flowers, and vegetables.

Trees. *Evergreens* are used as permanent screens and backgrounds of dark green for both winter and summer. Standing alone they beautify landscaped grounds. *Dwarf evergreens* are often used in "foundation plantings" on the north and west sides of houses, close to the foundations. They are also placed in groups at entrances and along boundaries, and to give interest to lawns or shrubby borders. *Deciduous trees*, or trees that drop their leaves in winter, are often used. Tall and wide-spreading trees are planted as shade trees on lawns, or in groups on large grounds for use as background plantings. They also form screens and windbreaks. Flowering deciduous trees, such as magnolias and dogwood, add beauty to landscape effects. *Orchard fruit trees* give both food and beautiful spring blossoms, while *nut trees* give shade and food.

Shrubs. *Evergreen shrubs* are used in borders and for group plantings. They include arbovitae, junipers, and cedars. Many of these have cones or berries like tall evergreen trees. Their permanent green color is attractive. Very dwarf or creeping types are planted on banks or slopes and in the rock garden. *Broad-leaved evergreen shrubs*, like rhododendron, azalea, and laurel, are used in groups or borders in shady spots to give permanent green plus showy flowers. *Deciduous shrubs* for borders, groups, and specimens are popular because of their beautiful flowers. These include lilac and hawthorn. Many also bear berries which give fall and winter color and attract birds.

Flowers. There are three important kinds of flowers in the gardens. *Perennials* live from year to year, though the tops may be killed back to the ground by frost. These plants are the "backbone" of the border. Favorites are bleeding heart, delphinium, hardy chrysanthemum, and phlox. *Biennials* take two seasons to reach full maturity, and then they die off. Sweet William, forget-me-nots, and hollyhocks belong to this class. If they are planted in the early spring, many will bloom the first summer, live through the winter outdoors, and bloom again the second summer. *Annuals* reach maturity in a single season and then die. The seeds must be planted each spring. The plants bloom through the summer and fall and die. Among the most commonly grown are petunias, marigolds, and zinnias.

Two kinds of flowers grow from bulbs. *Hardy bulbs* bloom in spring. The best known are daffodils and tulips. They live through the winter outdoors. Garden lilies, which belong in the class of hardy bulbs, bloom in summer and fall. *Tender bulbs* do not live easily through the winter. They must be planted in spring to bloom in summer or fall, or forced in autumn to bloom indoors in winter. After blooming, the bulbs must be dug, dried, and stored until it is time to start them into growth again. Gladioli are an example of summer-flowering tender bulbs (or corms). Amaryllis is one of the winter flowering sorts which is often grown in a pot in the window garden.

Vegetables. There are annual and perennial vegetables. *Annual vegetables* include roots like beets and carrots, bulbs like onions (most onions are biennial but grown usually as annuals), seed crops like peas and beans, vine crops such as the squashes and melons, fruit vegetables such as tomatoes and eggplant, and "leafy" sorts like spinach. Some annual vegetables are quite hardy and can be planted early in spring. Others are tender and should not be planted until the ground is warm. *Perennials* include asparagus, horseradish, and rhubarb, which stay in the ground and produce crops year after year.

Requirements for Successful Gardening

Most garden plants grow best in sunshine. The ideal piece of land for a flower border or bed, or a vegetable patch, slopes gently to the east and south. Flat areas open to the sun throughout the day also provide ideal growing conditions for garden plants. Trees and shrubs can be planted to the north and west of the garden. These will protect the garden plants from frosts and winter winds. The eastern and southern sides of the plot should be open to the sun unless the plants to be used grow better in the shade.

It is not always possible to find the ideal spot for a garden on one's land. In such a case the area which comes nearest to fulfilling the above conditions is chosen.

In some cases soil, altitude, climate, or other local conditions are unusually difficult. This may be true in a deep woodland, a desert area, or where winters are extremely severe. Only plants which can best adapt themselves to these conditions should be planted at first. The gardener can then gradually experiment with others until he establishes a successful garden.

Soil which is in good condition is necessary for success. It must not be too wet or too dry. It should be moist, yet well drained. Very sandy soil, or very heavy soil (clay), will need to have large quantities of decayed vegetable matter, or *humus*, added. Even good garden loam is improved by yearly additions of humus and commercial fertilizers.

Planning the Garden

Gardeners should decide what will grow best in any certain garden, and what succession of plants will be needed for the season, before buying seeds or plants.

Flowers. A bed or border of spring flowering bulbs can later be planted with flowering annuals which are set in over the bulbs without moving them. Dry sandy beds, banks, and slopes can be planted with such flowers as

GARDENING



FOOD



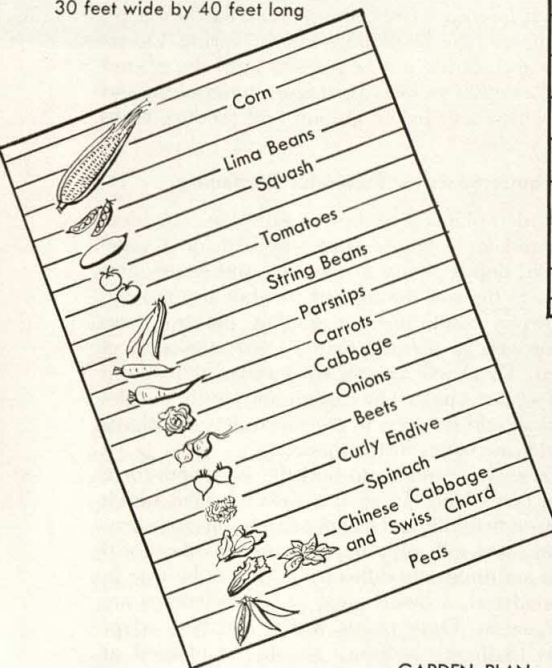
RECREATION
AND
EXERCISE



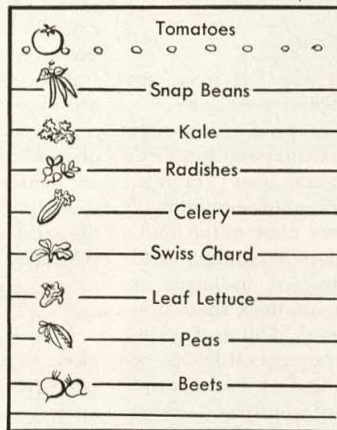
BEAUTY

VEGETABLE GARDENS

GARDEN PLAN
30 feet wide by 40 feet long



GARDEN PLAN
20 feet wide by 30 feet long



A Home Vegetable Garden should be planned to suit the gardener's taste and needs. The main purpose of the garden is to provide the grower with a supply of fresh, hard-to-buy vegetables. Vegetables which grow quickly may be picked, and the soil may be used for a different vegetable in the same season. Fertilizer is used to enrich the soil and give vegetables a high vitamin content.

Depth for Planting
Vegetable Seeds



Tomato

1/4 inch



Cabbage



Lettuce



Radish



Turnip

1/2 inch



Carrot



Onion



Parsley



Spinach



Beet

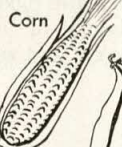
1 inch

Cucumber



Muskmelon

Squash



Corn

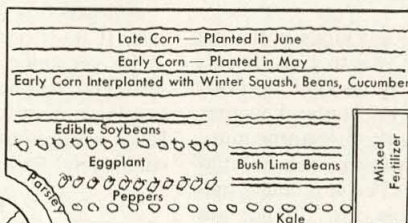
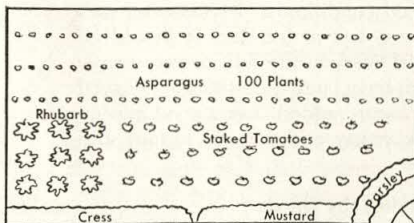
Pea



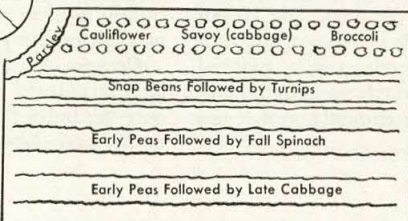
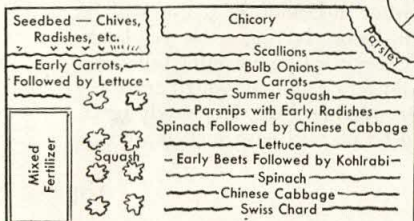
Bean

2 inches

GARDEN PLAN
50 feet wide by 100 feet long



Herbs



5'

THE HEIGHTS OF SOME WELL-KNOWN GARDEN FLOWERS

4'

3'

2'

1'

Rock Cress

Begonia

Cockscomb

Blanketflower

Bachelor's-Button

Canterbury Bell

Snapdragon

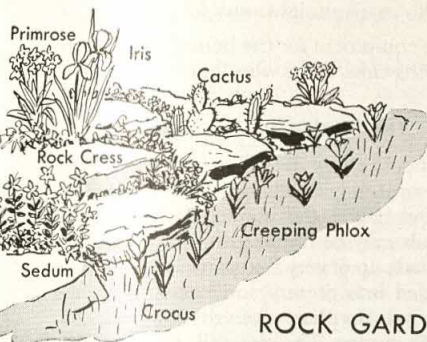
Lychnis

Blue Sage

Larkspur

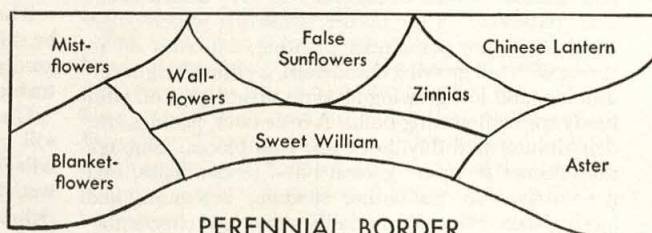
Hollyhock

Sunflower

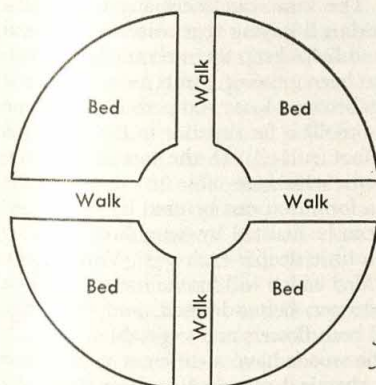


ROCK GARDEN

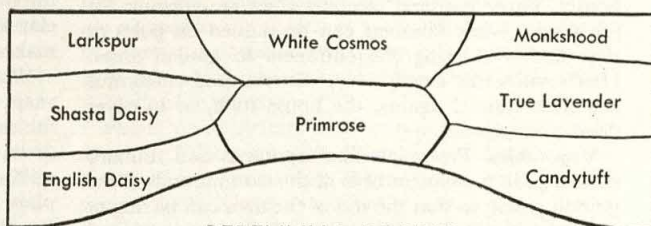
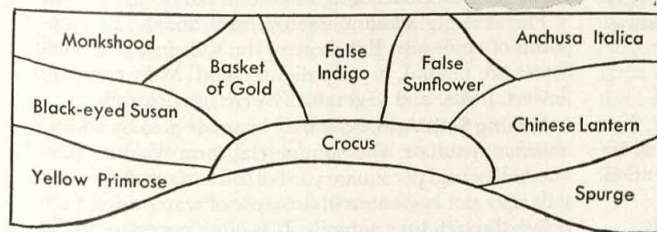
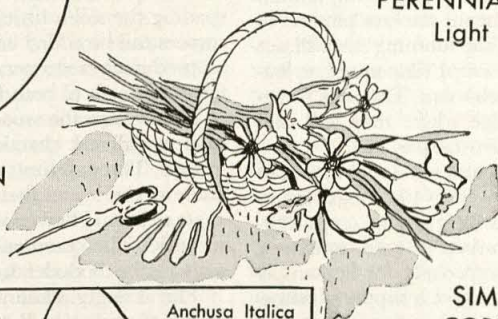
Flower Gardens should be planned to improve the appearance of the landscape around a house. The height, color, and size of the garden should be determined by the surrounding area. After the location is decided, the available type of soil should be taken into consideration. Border gardens are used to line driveways and sidewalks, or points of interest. They look especially good before a background of shrubbery.

PERENNIAL BORDER
Colors with Strong Contrast

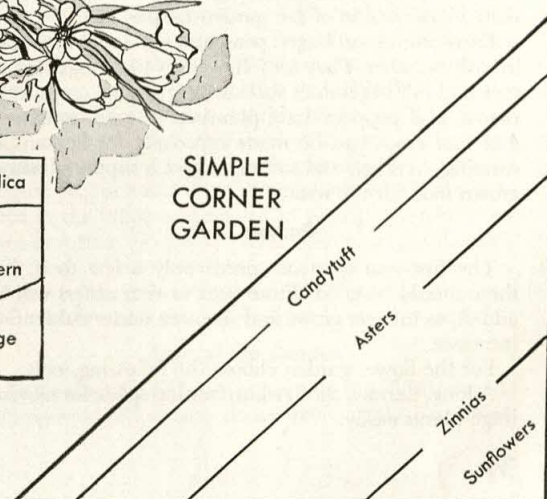
FLOWER GARDENS



FORMAL GARDEN

PERENNIAL BORDER
Light ColorsPERENNIAL BORDER
All Yellow Flowers

SIMPLE CORNER GARDEN



GARDENING

perennial phlox or annual portulaca. Moist woodland gardens will do best if planted with woodland flowers like violets.

Beds on the west or north of the house, in shade, can only be planted to something like ajuga, pachysandra, myrtle, or broad-leaved evergreen shrubs and perennials which like shade, such as bleeding-heart, coral-bells, hosta, and campanula.

Borders and beds in full sun where the soil has been well prepared and enriched make the best show. Here a succession of flowers can be raised to give color from spring until hard freeze. The planting can be all annuals, put in each year. Low plants should be placed in front, medium height plants in the center, and tall plants, like cosmos and giant zinnias, in the background.

A border may also be hardy, herbaceous, or perennial. The latter remains from year to year while tender bulbs and annuals are set in annually to give added color. The "backbone" of the border, consisting of perennials which form the permanent planting, can start off in spring with tall growing *donicum*, medium-height columbine, and low-growing *alysium saxatile*, set off with hardy spring flowering bulbs. A little later, peonies, iris, delphinium, and daylilies come into bloom. Through midsummer there are garden lilies, tender bulbs, and perennials like *galliardia*, *stokesia*, *helenium*, and hardy phlox. For autumn hardy asters and *chrysanthemum* are best.

Roses should usually be grown in beds especially devoted to them. Some groups of hardier hybrids, like the floribunda or polyantha, may be used in the mixed border. Large flowered creeping roses are effective for fall banks, while climbers can be trained on poles or over arches marking the entrances to garden areas. Hardy vines like English ivy, winteria, and *exonymus* are often trained against the house itself, or to cover dead trees or walls.

Vegetables. Perennials like asparagus and rhubarb should go in permanent beds at the extreme ends of the garden patch, so that the rest of the area can be dug or plowed without disturbing them. Tall-growing annual vegetables like corn and pole beans are best planted to the west of low growers so that the morning sun will not shade the lower plants. Vine crops like squashes, cucumbers, and melons need much room. They can sometimes be planted along an edge where they will trail their vines outside of the garden proper.

Early onions, cabbages, peas, and root crops come out in early summer. They are followed by plantings of summer and fall vegetables such as beans, vine crops, eggplants, and peppers. Late plantings of corn, tomatoes, and root crops can be made especially for September canning, freezing, and storing to give a supply of home-grown food for the winter.

Garden Tools

The first-year gardener needs only a few tools, but these should be good. From year to year others will be added, as interest grows and the area under cultivation increases.

For the flower garden choose the following tools:

A long, narrow, sharp transplanting spade for moving large plants easily.

A spading fork, for digging and forking over the ground.

A hoe, preferably a narrow-bladed onion hoe, for cultivating and weeding.

A rake, for smoothing the surface soil and removing grass cuttings and leaves.

A strong, well-made trowel, for transplanting.

A hand weeder with a sharp, curved, knife-like blade.

For the vegetable garden add these tools:

A strong broad spade or long-handled shovel for heavy digging.

A standard-sized hoe for opening furrows.

A scuffle hoe for cultivating between rows.

A garden line, to mark straight rows for planting.

Other desirable equipment for the home gardener includes hose, watering cans, and a wheelbarrow or garden cart.

The Garden Soil

The gardener should study the soil in his plot. It may be stubborn clay, or it may be almost sterile sand. The gardener must understand the methods whereby the texture of such soils may be improved.

Clay soils are made up of very fine particles. Fine clay soil may be molded into pottery and baked. A somewhat similar process takes place when the sun shines on wet clay soil in the garden. The clay soils are generally rich in plant food but are poorly drained. Clay soils can be improved by adding plenty of leaf mold, well-decayed manure, peat moss, or other humus to them.

Sandy soils are very loose in texture and warm up quickly in the spring. They let the moisture drain through readily. The same treatment suggested for a clay soil helps. Adding decaying vegetation to sandy soil makes it richer and helps keep the moisture in the soil.

When a soil has been growing plants for a number of years, it gradually becomes loose and porous. With time the surface soil (topsoil) is far superior to that which is down perhaps a foot (subsoil). In the topsoil there are millions of bacteria which are able to transform the plant foods into a form that can be used by the plants. But this process can be assisted by extra feeding, or by spading the soil a little deeper each year. Various substances can be added which will hasten nature's process in producing a deeper, better-drained, and richer soil for the growth of both flowers and vegetables.

The soils in the woods have a different texture and often a different chemical composition from those of a garden. Through time, such soils often become acid because of the leaves that have accumulated in them. In these soils, wild flowers which demand acid soil grow luxuriantly. The component of the shrubs found in acid soils are the rhododendron, mountain laurel, and azalea.

The strongly alkaline western soils are the very opposite of acid soils. But most of the soils in the United States are neutral, or only slightly acid. Most common flowers, fruits, and vegetables thrive in such soils.

Making Soils Acid. Soils may be made acid by adding aluminum sulfate, the commercial form of alum. Use one-half pound per square yard of soil surface. Even then soils may not become acid, because of water rising from below through lime subsoils. It is often necessary to dig out the beds to a depth of three feet and to fill these spots with a definitely acid soil from the woods, perhaps

adding sand, peat moss, or leafmold.

Use of Lime. Soils may be rendered neutral by applying lime. Lime is not a plant food or fertilizer, but it is an aid to the soil. It serves many useful purposes besides sweetening a sour soil. It makes other plant foods available. It cements together fine particles of clay, and it makes sandy soil more compact. It also helps decay leaves for use as fertilizers. Lime may be used as ground limestone, hydrated lime, or air-slaked lime.

Plant Foods. Many chemical elements are found in plants. Most of the elements needed for plant growth are abundant in the usual soils. Nitrogen, phosphorus, and potash are the three elements essential to plant growth and most readily exhausted from soils by plants. That is why these three elements often have to be added to the soil.

Nitrogen may be added in the form of nitrate of soda, ammonium sulfate, or manure. Phosphorus can be purchased as bone meal or superphosphate. Potash is found abundantly in wood ashes. It is sold as potassium sulfate and muriate of potash.

Plant-food manufacturers have prepared combinations of these three important elements in varying proportions to give all-around nourishment, which contains all the elements essential for growth. This is known as a highest, complete plant food or fertilizer.

Manure also contains a small percentage of all the essential elements for plant growth. But the food elements are found in very small quantities. Its main value is in improving the texture of the soil, through the humus which it contains. It is more expensive to purchase manure for its plant food content alone than to buy the commercial chemical foods.

Digging the Soil. As soon as the garden has finished its period of beauty in the fall of the year, the soil should be thoroughly spaded to a depth of a foot. It should not be taked smooth, but allowed to remain rough through the winter, so that the moisture will sink into it. Freezing and thawing will help to pulverize the soil. Such a garden spaded in the fall will be ready to work when spring arrives, and will be the ideal soil in which to sow the seeds. The usual practice, unfortunately, is to wait until the spring, when the soil cannot be worked as easily as it can be in the fall before it freezes.

When the soil is spaded, some well-rotted manure, peat moss, garden trash, and decayed leaves should be spaded into it. All of these are known as soil conditioners. These sorts of materials are spread on the soil and then worked into it during the spading. In spading, the gardener should take thin slices of the soil with the spade or fork and turn each shovelful completely over so that the garden trash is buried.

In the vegetable garden, a cover crop of winter rye may be planted as soon as crops are out of the ground. This will remain green all winter and can be forked or plowed under in very early spring when it is about 6 inches tall.

Before planting, the soil should be carefully raked so that its surface is level. Otherwise, there will be spots which are hollow and which will collect more moisture than others.

Planting the Garden

Planting Seeds. Seeds may be sown indoors in boxes in March or early April before they can be put into the

open soil. This gives the plants an earlier start. Among the commonest seeds sown indoors are tomatoes, cabbage, celery, verbena, zinnia, marigold, China rose, and other annuals. These plants need a little longer growing season than is normal outdoors.

The seeds are usually scattered on the surface of the soft soil, pressed in with a smooth board, and covered with burlap until the seed has sprouted. Larger seeds are sown at a depth of about twice their diameter.

When to Sow. Hardening time varies according to localities and years. Some experienced gardeners follow the fruit-tree calendar. They plant the hardy vegetables such as onion, lettuce, radish, spinach, leek, parsnip, and the like when the peach and pear trees are in bloom. They also plant such hardy annuals as cornflowers, marigold, pet marigold, and larkspur. When the apple blossoms appear, gardeners then plant the more tender varieties such as bean, corn, melon, pumpkin, cucumber, and most of the flowers.

Bulbs are planted according to their blooming times. Hardy spring-flowering bulbs like daffodils, tulips, and the minor bulbs like muscades, together with garden lilies, should be planted in the fall from September to November. They are planted in well-prepared beds to which fertilizer has been added at a rate of three to five pounds a hundred square feet. Most hardy bulbs should be planted at depths equal to four times their own diameter. Stem-rooting lilies, which root along the underground stem as well as on the bulb, go in much deeper, from eight to twelve inches.

Tender summer-flowering bulbs, corms and tubers like gladiolus, iris, and tuberous-rooted leguminosae, are planted in the garden in spring. Before a hard frost in autumn, they should be dug up, dried off, and stored in places which are above freezing temperatures until the following spring.

Plants are sometimes purchased from a grower ready to set out. These must be planted according to his instructions as to such things as type of soil, fertilizer, and sun or shade. Good general rules are to plant in the evening or on a wet day, as soon as possible after the plants are received. Place in a hole large enough to accommodate the root ball. The plants should then be watered thoroughly and kept shaded from the heat of the sun with a basket, newspaper, or other loose covering until the plant is growing well.

A cold frame is extremely useful to the home gardener. Seeds can be sown in a frame several weeks before they are safe in the open ground. Young tomatoes, cabbage, cauliflower, and broccoli plants started indoors, can be transplanted or potted up and "hardened off" in a frame for a couple of weeks before they are set in the open ground. Perennial flower seeds planted in a frame in August produce sturdy seedling plants which are wintered in the frame and set out in their permanent positions in spring. Delicately hardy perennial plants, such as hybrid chrysanthemums and thymus, are safe over winter in a frame. Lemon and cherry plants set in a frame in September will provide food well into the winter.

Care of the Garden

Cultivating the Soil means keeping it well fed, aired, and watered. Gardeners occasionally apply plant food

GARDENING

and dig it into and through the topsoil.

In order to keep the moisture in the soil and to keep weeds down, gardeners often place peat moss, straw, or even partly decayed leaves around perennials as well as around vegetables. Whether or not this extra mulch is applied, the surface layer of the soil should be kept stirred. This may be done with a small hoe. Digging too deeply may injure roots.

Weeds not only are unsightly but they also rob the garden plants of food and moisture. The fight against weeds must begin the minute they send their unwelcome sprouts through the earth. The younger they are the easier they are to uproot, and if the war is well fought at the beginning of the season the later struggle will be less strenuous. Mulching and cultivation discourage weeds.

Many plants, such as tomato, cosmos, delphinium, and other tall annuals and perennials, will need to be staked through the summer. These plants should be supported so that they stand gracefully, rather than bundled into a thick mass.

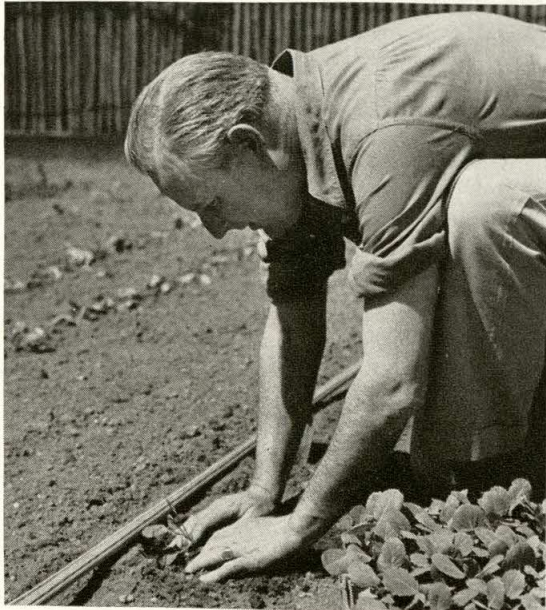
As soon as the garden is out of bloom the old flowers and developed seed pods should be removed.

Watering. There are two schools of thought in the matter of artificial watering. Some persons believe watering "softens" plants and keeps them from developing long, strong roots which will find moisture even in dry weather. Others feel plants must have plenty of moisture and that if nature does not provide it, the gardener must. Those in the second group usually have more prosperous and beautiful gardens.

Watering, when it is necessary, should be done thoroughly. Sprinkling here and there with a hose to dampen the surface and the plant leaves does more harm than good. A slow deep watering which wets the earth

Many Vegetable and Flower Seeds Are Best Sown in shallow boxes rather than in the open ground. When the young plants are big enough to handle, they are transplanted.

H. Armstrong Roberts



H. Armstrong Roberts

Loosening the Soil with a Hand Cultivator. Tools such as the one shown are too small for large, commercial gardens, but are ideal for good-sized home vegetable gardens.

to a depth of 4 to 6 inches will last a week to ten days even in dry weather. If it is done in the evening there will be less evaporation and loss of moisture. If water is run slowly into a bed from a hose with the nozzle removed, it does no harm to water plants even in the sunshine.

Insects and Disease. Insects harm garden plants in two ways: they devour the plants, and they suck their juices. For the chewing insects, a poison such as arsenate of lead, rotenone, or pyrethrum, sprayed or dusted on the leaves is effective. For sucking insects use a spray or dust of nicotine sulfate or rotenone. Cutworms and slugs, which work at night, must be trapped by a poison bran bait made by mixing arsenate of lead or Paris green with molasses and wheat bran. No definite proportions are necessary. The mushy mixture should be hidden under a flowerpot or heavy board so that birds or pets will not eat it and be poisoned.

Making Gardening Pay

Many boys and girls earn spending money by planting flowers or vegetables. In so doing they often change an unattractive backyard or empty lot from a dumping ground into a place of beauty. Boys and girls often find customers for their produce, because there is always a demand for home-grown vegetables, fruits, and flowers.

Canning and preserving surplus vegetables and fruits of the garden is a home industry in which women and girls are finding a wide scope for profitable work. Practical instructions along this line can be secured from the United States Department of Agriculture.

Garden Helpers

Birds are insect eaters and therefore the gardener's friends. Phoebe, and other flycatchers like swallows catch insects on the wing. Chewinks, starlings, and others dig up and devour grubs which they find in the soil. A birdhouse, a drinking basin, a slab of suet, and a feeding station will help to bring birds to your garden and to keep them there, even in winter. Certain sorts

such as chickadees, nuthatches, titmice, and woodpeckers which winter in the north are especially glad to find food ready for them. Berried shrubs also help to attract birds.

Toads are also insect eaters, and therefore desirable garden helpers. Stones in a dark, cool corner or a box lying on its side under a bush will furnish the toad a home in which to live contentedly as assistant gardener. Garter snakes and king snakes also eat insects, and are not poisonous or harmful to man.

The Indoor Garden

Gardening indoors is an art in itself. In a sunny bay window or a sun porch, flowering house plants, decorative foliage plants, vines, and a few of the tougher cooking herbs like chives, parsley, and mint, can be grown in winter.

Most potted plants need all the winter sun they can get. Exceptions for north or east windows are African violet, ivy, philodendron, and some large-leaved begonias. Potted plants need more air-moisture than most modern centrally heated houses give. Each pot should be placed in a saucer filled with pebbles. Water standing in these saucers gives moisture. The pebbles keep the roots from rotting.

Water most house plants when the surface is dry. The plants should not be kept soggy. Cacti, succulents, and geraniums need less water than other house plants.

When plants are full grown or when they are about to bloom they should be given plant food, used according to the directions on the package, or with manure water diluted to the color of weak tea. *Do not* fertilize sickly, dying plants or those which are resting. These should have less water until new growth.

Repot house plants in spring or when their roots form a thick white fibrous network on the outside of the soil within the pot. You can tell when this network of roots has formed by knocking the plant gently out of the pot against a table edge or a wood post. Use a potting mixture of one part good loam or compost, one part sand, and one part peat moss or leafmold with a little bone meal and complete plant food. Add a four-inch potful to a bushel of soil. Spray glossy-leaved plants or wash them under the faucet once a week.

Soak large, thirsty plants like azaleas and hydrangeas in a bucket of water once a week until the moisture reaches the surface soil. Watch for insects, and if they appear, spray with Black Leaf 40 or other spray for sucking insects. Washing the plants also helps keep insects from the garden.

FREDERICK F. ROCKWELL

Related Articles. For a complete list of articles relating to gardening, see the PLANT LIFE section of the READING AND STUDY GUIDE. See also the following articles:

GARDEN CULTURE

Agriculture	Garden Club	Propagation
Arboretum	Grafting	Pruning
Blanching	Greenhouse	School Garden
Bonsai	Horticulture	Soil
Botany	Hotbed	Terrarium
Breeding	Hydroponics	Transplanting
Cold Frame	Insecticide	Truck
Disease (Diseases of Plants)	Landscape Gardening	Farming
Fertilizer	Lawn	Weed Killer
Floriculture	Plant Quarantine	Window Box
Fungicide	Pollen and Pollination	

KINDS OF PLANTS

Annual	Plant
Biennial	Seed
Bulb	Shrub
Flower	Tree
Fruit	Vegetable
Herb	Weed
Perennial	

UNCLASSIFIED

Bird (Importance of Birds; Planting to Attract Birds)	Four-H Club
Botanical Garden	Insect
Canning	Seven Wonders of the World
Food Preservation	Shakespeare Garden

Outline

- I. Kinds of Gardens
- II. Kinds of Garden Plants
 - A. Trees
 - B. Shrubs
 - C. Flowers
 - D. Vegetables
- III. Requirements for Successful Gardening
- IV. Planning the Garden
 - A. Flowers
 - B. Vegetables
- V. Garden Tools
- VI. The Garden Soil
 - A. Making Soils Acid
 - B. Use of Lime
 - C. Plant Foods
 - D. Digging the Soil
- VII. Planting the Garden
 - A. Planting Seeds
 - B. When to Sow
- VIII. Care of the Garden
 - A. Cultivating the Soil
 - B. Watering
 - C. Insects and Disease
- IX. Making Gardening Pay
- X. Garden Helpers
- XI. The Indoor Garden

Questions

- What are the chief values of gardening?
 What plants are often used for ornamental gardens?
 What are annual plants? Biennials? Perennials?
 On which sides of a garden should trees be planted?
 How can clay soil be improved?
 Why is lime added to soil? Why is ammonium sulfate used?
 What kind of shrubs are used in a garden?
 What tools are needed for a flower garden? For a vegetable garden?

GARDENING, LANDSCAPE. See LANDSCAPE GARDENING.

GARDINER, "CHUCK," CHARLES. See ICE HOCKEY (Famous Hockey Players).

GARDINERS ISLAND is about 130 miles east of New York City. It lies between the two eastern prongs of Long Island, northwest of Montauk Point. On its east are Block Island Sound and the Atlantic Ocean. Gardiners Bay lies to the west. For location, see NEW YORK (color map). The bay provides excellent deep-sea fishing. Gardiners Island covers almost 5 square miles. Lion Gardiner bought the island in 1639. It became the first permanent settlement by the English in New York state.

WILLIAM E. YOUNG

GARDNER, Mass. (pop. 19,038; alt. 1,030 ft.), lies in north-central Massachusetts (see MASSACHUSETTS [map]). The largest wooden chair ever built stands in the town. It is 18 feet tall. Gardner is sometimes called *The Chair City of the World*. Famous products include Boston rockers and baby carriages. The area was settled about 1764. Gardner has a mayor-council form of government.

GAREFOWL. See AUK.

JAMES A. GARFIELD

James A. Garfield



The United States Flag had 38 stars throughout Garfield's term of office.



GRANT
18th President
1869 — 1877



HAYES
19th President
1877 — 1881



ARTHUR
21st President
1881 — 1885



CLEVELAND
22nd President
1885 — 1889

Chicago Historical Society

20TH PRESIDENT OF THE UNITED STATES 1881

GARFIELD, JAMES ABRAHAM (1831-1881), was the last President to be born in a log cabin. Nobody knows what kind of President he would have been, because he was assassinated only a few months after taking office. Garfield, a Republican, was the fourth President to die in office, and the second to be assassinated.

Possibly Garfield accomplished more by his death than if he had lived to complete his term. National politics in his day had sunk to a low moral level. Party bosses controlled huge political machines that bought votes and sold political favors. The spoils system turned thousands of government employees out of their jobs every time a new President took office (see SPOILS SYSTEM). Garfield spent most of his short time as President filling these jobs with his political supporters. Although not a reformer, he wrote in his diary shortly before he was shot: "Some civil service reform will come by necessity after the wearisome years of wasted Presidents have paved the way for it." His assassination by a disappointed job-seeker shocked the nation into action. Two years later, Congress began civil service reform by passing the Pendleton Civil Service Act.

Garfield was a big, athletic, handsome man with blond hair and beard. Before becoming President, he was successful as professor, college president, Civil War general, and U.S. Congressman. He spoke and wrote well, read widely, and even composed poetry. He occasionally entertained his friends by writing Greek with one hand and at the same time writing Latin with the other. Warmhearted and genial, Garfield wanted to be well liked, and generally was. But his eagerness to please everyone sometimes led him into questionable dealings with unscrupulous men.

Early Life

Childhood. James Abram Garfield was born at Orange, Cuyahoga County, Ohio, on Nov. 19, 1831.

He was the youngest of five children. His parents, Abram and Eliza Ballou Garfield, were pioneers from the East. His father died when James was only 2 years old. But Mrs. Garfield lived to become the first woman to attend her son's inauguration as President. She managed to make a fair living on their 30-acre farm.

In his early teens, James began to do odd jobs during his vacations from the district school. At 17, inspired by reading adventure stories, he left home with the romantic idea of becoming a sailor on the Great Lakes. He gave up the notion when a ship captain cursed him and drove him away. A cousin then hired him to drive a team of horses that towed a barge along the Ohio Canal. During his six weeks on the canal, he recalled, "I fell into the canal just fourteen times and had fourteen almost miraculous escapes from drowning."

Education and Early Career. Soon James returned home, ill with malaria. When he recovered, he entered Geauga Academy in the nearby town of Chester. Following his first term, he supported himself by teaching in the district school. At 20, he enrolled in the Western Reserve Eclectic Institute (now Hiram College) at Hiram, Ohio, near Cleveland. He studied there for three years, then attended Williams College in Williamstown, Mass., for two years. Under the guidance of the president of Williams College, Mark Hopkins, Garfield matured greatly and broadened his interests. He later defined the ideal college as "a simple bench, Mark Hopkins on one end and I on the other . . ."

IMPORTANT DATES IN GARFIELD'S LIFE

- 1831** (Nov. 19) Born at Orange, Ohio.
- 1858** (Nov. 11) Married Lucretia Rudolph.
- 1862** Became youngest brigadier general in Union Army.
- 1862** Elected to U.S. House of Representatives.
- 1880** Elected President of the United States.
- 1881** (July 2) Shot by Charles Guiteau.
- 1881** (Sept. 19) Died at Elberon, N.J.

After graduation from Williams in 1856, Garfield returned to Hiram College as a professor of ancient languages and literature. The next year, at the age of 26, he was chosen president of the college. While president, Garfield studied law and occasionally preached sermons for the Disciples of Christ. He had joined that church as a youthful convert. He also delivered public lectures on such topics as "Geology and Religion."

Garfield's Family. On Nov. 11, 1858, Garfield married Lucretia Rudolph (April 19, 1832-March 14, 1918), the daughter of an Ohio farmer. She had been a student of Garfield at Hiram, and taught school while he completed his education. Garfield called her "Crete," and came to rely on her quiet strength. Later, when she was mistress of the White House, he wrote: "Crete grows up to every new emergency with fine tact and faultless taste." The Garfields had seven children, two of whom died as infants. One son, Harry Augustus Garfield (1863-1942), became president of Williams College, and served as Fuel Administrator under President Woodrow Wilson during World War I. Another son, James Rudolph Garfield (1865-1950), served as Secretary of the Interior in President Theodore Roosevelt's Cabinet.

Soldier. Shortly after the outbreak of the Civil War, Governor William Dennison commissioned Garfield a lieutenant colonel of Ohio volunteers. The young officer wrote home: "I am cheerful and happy as any one can be in such a fierce business as killing men." Garfield won a minor battle at Middle Creek, Ky., in January, 1862. As a reward, he was made a brigadier general, the youngest in the Union Army. He took part in the Battle of Shiloh and in the operations around Corinth. In 1863, as chief of staff under General William S. Rosecrans, Garfield distinguished himself in the Battle of Chickamauga by riding under heavy fire to deliver an important message to General George H. Thomas. He was promoted to major general after the battle.

Political Career

Congressman. Garfield had shown an interest in politics as early as 1856, when he campaigned for John C. Frémont, the Republican candidate for President. He was elected to the Ohio state senate three years later. In 1862, while still in the army, Garfield was

elected to the U.S. House of Representatives, although he did not resign his commission until December, 1863.

Garfield won re-election to the House eight times. He served as chairman of the Appropriations Committee, and as a member of the committees on Military Affairs, Ways and Means, and Banking and Currency. He supported the harsh Reconstruction measures of the Radical Republicans, and voted for the impeachment of President Andrew Johnson (see RECONSTRUCTION).

In 1872, Garfield was one of several congressmen accused of accepting gifts of stock from the Credit Mobilier, a corporation seeking favors from the government (see CREDIT MOBILIER OF AMERICA). He denied the charge, and it was never proved. Garfield was also criticized for accepting a \$5,000 fee from a company trying to get a paving contract from the city of Washington, D.C. He admitted taking the fee, but contended that his services were not improper.

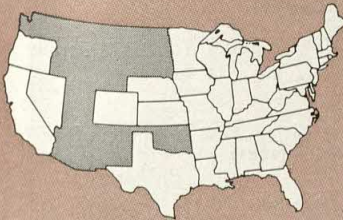
Garfield served on the commission that settled the disputed Hayes-Tilden election of 1876 (see ELECTORAL COMMISSION). He also helped draw up a bargain which gave the presidency to Rutherford B. Hayes.

During Hayes' administration, Garfield became floor leader of the Republicans in the House. The party was divided into two factions: the "Stalwarts," led by Senator Roscoe Conkling of New York, and the "Half-Breeds," led by Senator James G. Blaine of Maine. These groups quarreled over personal differences and government jobs rather than political principles. Though closer to the Half-Breeds, Garfield stood between the two factions and kept some of the confidence of both.

Election of 1880. The Ohio legislature elected Garfield to the U.S. Senate in 1880. But, before he could take his seat there, he led his state's delegation to the Republican national convention. The Half-Breeds tried to nominate Blaine for President. The Stalwarts insisted on former President Ulysses S. Grant. Neither Blaine nor Grant could gather enough votes for the nomination. The Half-Breeds then swung to Garfield, a "dark horse," or little-known candidate. The convention finally chose him on the 36th ballot. For Vice-President, the convention picked Chester A. Arthur, a Stalwart

THE WORLD OF PRESIDENT GARFIELD

U.S. population was 51,500,000 in 1881. No new states or territories were organized during Garfield's short administration.



Garfield Was Shot on July 2, 1881, and died on Sept. 19.



WORLD EVENTS

- 1881** Terrorists assassinated Alexander II of Russia.
- 1881** The French established a protectorate over Tunis.



Railroads Reached Texas in 1881, ending the famous cattle drives to Kansas cow towns.

Alexander II of Russia Assassinated



The American Red Cross was organized by Clara Barton.





The Western Reserve Historical Society

Garfield Was Born in Orange, Ohio. In this painting by James Hope, his birthplace is shown as it appeared during his childhood.

Lucretia Garfield aided her husband's career with her quiet strength.

GARFIELD'S ELECTION

Place of Nominating Convention. Chicago

Ballot on Which Nominated. 36th

Democratic Opponent. Winfield Scott Hancock

Electoral Vote. 214 (Garfield) to
155 (Hancock)

Popular Vote. 4,453,295 (Garfield)
to 4,414,082 (Hancock)

Age at Inauguration. 49

and Conkling's lieutenant in the New York Republican machine. Garfield defeated his Democratic opponent, Winfield Scott Hancock, by about 40,000 votes.

Garfield's Administration (1881)

The five Garfield children, ranging from 9 to 18, looked forward to moving into the White House. But the President was in a somber mood. He wrote: "I am bidding good-bye to private life and to a long series of happy years which I fear terminate in 1880."

Party Quarrels soon confirmed the President's fears. Garfield, who owed his nomination primarily to the Half-Breeds, favored this faction in handing out jobs. He made their leader, Blaine, his Secretary of State, and appointed several others to important offices. The Stalwarts received only minor positions. The angry Stalwart leader, Conkling, tried to prevent the Senate from confirming some key appointments. He failed, and resigned from the Senate.

Distracted by these quarrels over jobs, Garfield could give little attention to government business. He did support an investigation by Postmaster General Thomas L. James, who discovered frauds in the awarding of Star Route mail contracts (see STAR ROUTE).

Assassination. On July 2, 1881, Garfield was about to leave Washington to attend the 25th reunion of his class at Williams College. As he stood in the railroad station, a stranger stepped out of the crowd and fired two pistol shots at him. Garfield fell, and the assassin

cried: "I am a Stalwart and Arthur is President now!"

The assassin, Charles J. Guiteau, was arrested immediately. He held a grudge because Garfield had refused to appoint him as United States consul in Paris. At his trial, Guiteau acted like a madman. His attorney argued that he was innocent by reason of insanity, but a jury convicted him. He was hanged in 1882.

Garfield lay near death for 80 days. Although one of the assassin's bullets had merely grazed his arm, the other had lodged in his back. Surgeons could not find it. Alexander Graham Bell tried unsuccessfully to locate the bullet with an electrical device.

Garfield remained calm and cheerful throughout the hot summer in Washington. He performed only one official act, the signing of an extradition paper. The Constitution provides that, in case of a President's "inability to discharge the powers and duties" of his office, "the same shall devolve on the Vice-President." But Arthur did not step in, for fear of disturbing Garfield. The Cabinet supported his decision.

If the X ray and modern antiseptics had existed at that time, Garfield's life might have been saved. But infection set in. After being moved to a seaside cottage at Elberon, N.J., he died on Sept. 19, 1881. He was buried in Cleveland. Friends raised a large fund to help Mrs. Garfield and their children.

RICHARD N. CURRENT

Related Articles in WORLD BOOK include:

Arthur, Chester A. Hopkins, Mark
Civil Service (History) President of the United States
Hancock, Winfield Scott Spoils System

Outline

I. Early Life

A. Childhood
B. Education and
Early Career

C. Garfield's Family
D. Soldier

II. Political Career

A. Congressman

B. Election of 1880

III. Garfield's Administration (1881)

A. Party Quarrels

B. Assassination

Questions

Why did Vice-President Arthur not assume the duties of the presidency while Garfield lay dying?

What adventure grew from Garfield's love of reading?

How did Garfield's death affect government reform?

Who were the Stalwarts? The Half-Breeds? How did their rivalry lead to Garfield's nomination?

Why did Garfield never take his Senate seat?

How long did Garfield serve as President? Who served a shorter term?

GARFIELD'S CABINET

Secretary of State. *James G. Blaine
Secretary of the Treasury. William Windom
Secretary of War. *Robert Todd Lincoln
Attorney General. Wayne McVeagh
Postmaster General. Thomas L. James
Secretary of the Navy. William H. Hunt
Secretary of the Interior. *Samuel J. Kirkwood

*Has a separate biography in WORLD BOOK.

GARFISH. See **GAR.**

GARGANTUA, *gahr GAHN tyoo uh*, **AND PANTAGRUEL**, *pan TAG roo ell*, by François Rabelais, is a satire on French society in the 1500's. Gargantua and his son Pantagruel are giants with enormous appetites. They take part in fantastic adventures, through which Rabelais pokes fun at the customs of his day. But, behind the humor, Rabelais expresses serious ideas about such subjects as education, politics, and religion. The work was published as a series of separate books, beginning in 1532. See also **RABELAIS**, **FRANÇOIS**.

GARGLE, *GAHR g'l*, is a germ-killing liquid used for a sore throat. The patient takes a mouthful of liquid, throws his head back, and churns the liquid about his throat by saying *a-a-a-h* without swallowing the liquid. Many formulas are used for making gargles. The simplest gargle is one teaspoonful of common table salt and one of baking soda added to a pint of water. X-ray studies show that often the liquid does not reach far enough into the throat to help.

HEBER W. YOUNGKEN

GARGOYLE, *GAHR goil*, is a decorated water spout projecting from the upper part of a building, usually from the roof gutter. In order to drain water off roofs, ancient Greek architects often placed terra-cotta or marble lion heads on the roof cornice. The water emptied out of the lions' mouths. Gothic architects used this same idea in their gargoyles, which were drainspouts designed to protect building walls from rainwater that ran down from the roof.

Gargoyles became important features of Gothic buildings. They are weird stone figures, half-human and half-animal or half-bird, placed on the roof edges of cathedrals, palaces, and other buildings. A channel inside the gargoyle conducts the rainwater from the roof. Gargoyles project away from the sides of buildings as much as three feet, making the rainwater fall far away from the building walls.

Sculptured Gargoyles serve as decorative waterspouts on the sides of a medieval Gothic cathedral in Freiburg, Germany.

Lester B. Bridaham



GARLAND, HAMLIN

The witty stonemasons of the Gothic period often used gargoyles to portray their patrons or colleagues in grotesque form. The word *gargoyle* comes from the Latin word *gurgulio*, meaning *gullet*, a meaning which refers to the draining purpose. People often apply the word incorrectly to grotesque figures not used for drains. The correct word for figures of this kind is *chimères*, or *chimaeras*.

SYBIL MOHOLY-NAGY

See also **CHIMAERA**.

GARIBALDI, *GAR uh BALL dee*, **GIUSEPPE** (1807-1882), was a military hero who fought to unite Italy into a single kingdom. He went to South America after taking part in an unsuccessful rebellion against the king of Sardinia in 1834. There he won fame fighting for the Brazilian state of Rio Grande do Sul, which was in revolt against the Brazilian government. He also fought for Uruguay, which was struggling against Argentina to preserve its independence.

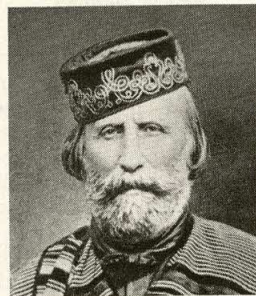
In 1848, Garibaldi returned to northern Italy to help the Lombards fight their Austrian rulers. The next year, he commanded an Italian legion that tried in vain to defend the newly formed Roman Republic against French and Austrian troops sent there to restore the pope. Then he went to the United States, and worked for a time as a candlemaker on Staten Island, N.Y. In 1854, he returned to Italy and settled down as a farmer.

In 1859, Garibaldi took part in the Sardinian war against Austria. In 1860, with the aid of his famous volunteer troops, "the red shirts," he conquered the Kingdom of the Two Sicilies for the Kingdom of Italy, which was just coming into being (see **SICILIES**, **KINGDOM OF THE TWO**). He then resigned his command to King Victor Emmanuel II. In 1862, and again in 1864, Garibaldi tried to capture Rome from the pope against the wishes of Victor Emmanuel. But he failed, and Rome did not become part of the Kingdom of Italy until 1870. In 1874, Garibaldi was elected to the Italian Parliament. He was born in Nice, France. R. JOHN RATH

See also **ITALY** (The Unification); **VICTOR EMANUEL (II)**.

GARLAND, AUGUSTUS H. See **ARKANSAS** (Famous Arkansans).

GARLAND, HAMLIN (1860-1940), an American novelist, protested in his early fiction against the hard life of overworked farmers. One of his typical short stories, "Under the Lion's Paw," attacks landowners who take unfair profits when their tenants improve the land. His *Main-Travelled Roads* (1891), a collection of short stories, was the first of a series of books set in the Midwest. In *Crumbling Idols* (1894), Garland attacked literary tradition and presented his ideas on fiction writing. One of his most notable novels is *Rose of Dutcher's Coolly* (1895). He won a Pulitzer prize in 1922 for *A Daughter of the Middle Border*, one of a series of autobiographical tales of his youth.

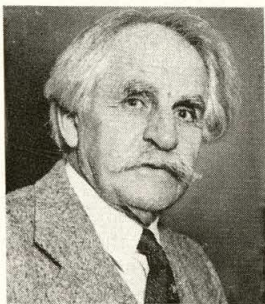


Chicago Historical Society

Giuseppe Garibaldi

GARLIC

Garland was born on a farm near West Salem, Wis. He educated himself largely by studying in an attic room near the Boston Public Library. In 1907, he founded the Cliff Dwellers, a group of people in Chicago interested in the arts. Besides fiction, Garland also wrote poems, biographies of Ulysses S. Grant and Theodore Roosevelt; and a play, *Under the Wheel*. He opposed overemphasis on sex in fiction, although his *Rose of Dutcher's Coolly* was originally banned. Garland's *Roadside Meetings* (1930) and



United Press Int.

Hamlin Garland

other memoirs help in understanding the many writers whom Garland knew intimately.

HARRY H. CLARK

GARLIC is a plant grown for its pungently flavored bulb, which is used to season foods. The onion and its close relatives possess the same strong-tasting compound as garlic, but in different amounts. The garlic bulb is made up of parts called *cloves*. These cloves are eaten, and are also used for planting, because garlic produces no seed. A brittle, papery covering grows around each clove, as well as around the whole bulb. The garlic plant originally grew in middle Asia.

Farmers plant the crop early in spring and the bulbs mature early in fall. Before planting, the cloves are separated by compressed air. They must be planted by hand so that the base of the clove is always in the bottom of the furrow. As the garlic matures, the plant leaves die.

The bulbs are *cured* by drying in the field. Workers then braid the tops or remove them, and the garlic is ready for market. The bulbs may be sold whole or ground into powder, or the juice may be extracted and sold.

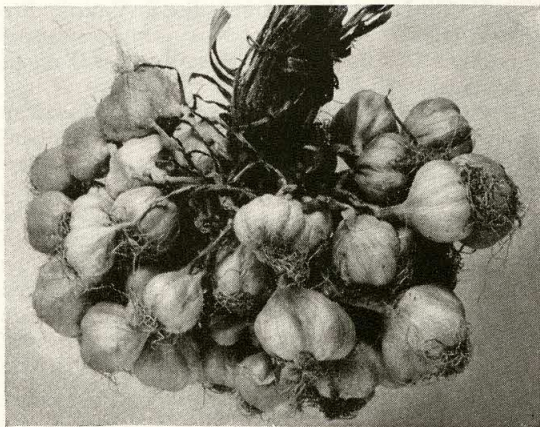
Scientific Classification. Garlic belongs to the amaryllis family, *Amaryllidaceae*. It is genus *Allium*, species *sativum*.

JOHN H. MACGILLIVRAY

See also Onion.

Garlic Bulbs Are Bunched for the Market.

U.S.D.A.



GARMENT INDUSTRY. See CLOTHING.

GARMENT WORKERS' UNION, INTERNATIONAL LADIES', is a labor union for workers employed in the manufacture of women's and children's clothing. It has local unions in the United States and Canada. The union was founded in 1900, when it received a charter from the American Federation of Labor. It left the A. F. of L. in 1935 to become a charter member of the Congress of Industrial Organizations, but withdrew to rejoin the A. F. of L. in 1940. The Garment Workers union has headquarters in New York City. For membership, see LABOR (table).

FREDERICK F. UMHEY

GARNER, JOHN NANCE (1868-), served as Vice-President of the United States from 1933 to 1941, during the first two terms of President Franklin D. Roosevelt. Garner helped put through the early New Deal program, but later broke with Roosevelt and opposed the President (see NEW DEAL). He actively opposed a third term for Roosevelt and ran against him unsuccessfully at the 1940 Democratic National Convention.

Garner was born in Red River County, Texas, and was often called "Cactus Jack." He served in the United States House of Representatives as a Democrat from Texas from 1902

to 1933. He was elected Speaker of the House in 1931. A shrewd politician, he sought the Democratic presidential nomination in 1932. But he traded his convention votes with Roosevelt and got the vice-presidential nomination instead.

IRVING C. WILLIAMS

GARNERIN, gahr nuh RAN, ANDRÉ JACQUES (1769-1832), was the first man to drop from a balloon in a parachute. He made the drop on Oct. 22, 1797, over the Parc Monceau in Paris. The parachute he used was only eight yards in diameter.

Garnerin was born on Jan. 31, 1769, in Paris, and began making models of balloons while still a schoolboy. At 25, he joined the French Revolution, and was held a prisoner of war in Hungary for two years. When he returned to France, he resumed his interest in ballooning, and helped popularize parachute jumping. See also PARACHUTE.

ROBERT B. HOTZ

GARNET includes several types of minerals. Precious garnets, used for jewelry, include the ruby-red *pyrope*, or *Bohemian garnet*, and the transparent *almandine garnet*. The garnet is the January birthstone. Gem garnets are mined chiefly in Kimberley, South Africa, and in Arizona and Colorado. *Common garnets* are found in many silicate rocks. They range in color from deep red to brown and black, and sometimes are yellow and green. Industry uses these garnets to cut and polish gem stones, and also for watch jewels. See also CARBUNCLE; RUBY.

GARNISHMENT is a legal process by which the credits or property of a debtor, in the hands of a third party, may be held for payment of debts. In most states, only wages above those necessary to live on can be attached from a debtor's salary. See also ATTACHMENT.



United Press Int.

John Nance Garner

GARONNE, *guh RAHN*, **RIVER** is the largest river in southwestern France. The 385-mile-long river begins in the Spanish Pyrenees and moves across the border into some of France's richest farm land. Just north of Bordeaux, the Dordogne River joins the Garonne to form the Gironde Estuary. Large ocean vessels can easily sail up the river to Bordeaux, one of France's chief ports. Small vessels go as far as Toulouse, where a small canal continues southeast to the Mediterranean Sea. For location, see **FRANCE** (color map).

JACK R. VILLMOW

GARRETT, PATRICK FLOYD (1850-1908), an American frontier sheriff and ranchman, was best known for capturing and later killing, the outlaw, Billy the Kid. Garrett was elected sheriff of Lincoln County, New Mexico, in 1880, and captured Billy the Kid late that year. After Billy escaped from the jail in which he awaited hanging, Garrett found him in July, 1881, and shot him.

Garrett was born in Alabama, and became a cowhand and later a buffalo hunter. Garrett was murdered by an assassin on a mountain road. WAYNE GARD

See also **BILLY THE KID**.

GARRICK, GAR ick, DAVID (1717-1779), was perhaps the greatest English actor of his time. He also managed the Drury Lane Theatre in London,



Brown Bros.

David Garrick

and wrote plays. He was versatile and astounded audiences with his mobility and the naturalness of his acting in tragedies, comedies, and farces. He helped revive Shakespeare's plays in their original form. Born in Hereford, he went to London in 1737 with his tutor, Samuel Johnson, the famous critic. Garrick tried business, but soon turned to the theater. MARSTON BALCH

GARRISON is a military post. See **FORT**.

GARRISON, WILLIAM LLOYD (1805-1879), was an American journalist and reformer who became famous in the 1830's for his denunciations of slavery. Before his time, abolitionists had made moderate appeals to slaveholders and legislators in behalf of slaves, and hoped that slavery would gradually disappear. Garrison said slavery ought to be ended "immediately," and criticized all who did not entirely agree with him.

Garrison was born on Dec. 10, 1805, and was raised in Newburyport, Mass. A poor boy, he was apprenticed to a printer at 13. By 1827 a veteran journalist, he edited the *National Philanthropist*, the world's first temperance paper. He met Benjamin Lundy, a Baltimore publisher, in 1828, and became an ardent abolitionist. His attacks on slave dealers in Lundy's newspaper caused Garrison to be jailed. In 1831, he began to publish *The Liberator* in Boston. It

William Lloyd Garrison

Chicago Historical Society



GARTER, ORDER OF THE

had a small circulation, but was influential. Garrison continued to issue it until 1865, when the Thirteenth Amendment to the Constitution ended slavery.

In 1832, Garrison formed the first society for the immediate abolition of slavery. He attracted such associates as Wendell Phillips, and influenced, among others, Theodore Parker and Henry David Thoreau. In 1835, Garrison's life was endangered by a mob in Boston. His fight to give women equal rights in the American Anti-Slavery Society, formed in 1833, split the abolitionist movement. He believed that the northern states ought to separate from the South. He refused to vote, and opposed the United States government because it permitted slavery. But he eventually approved of Abraham Lincoln and supported his administration during the Civil War.

LOUIS FILLER

See also **ABOLITIONIST**.

GARRISON DAM, about 77 miles north of Bismarck, N.Dak., is part of the federal government's Missouri River Basin development program. It is one of the largest rolled-earth fill dams in the world. The main section is 11,300 feet wide and 210 feet high. The town of Riverdale was built nearby to house project employees. Construction of the dam started in 1947. The first of five generating units began to produce power in 1956. When all the units go into operation, the dam will have a capacity of 400,000 kilowatts. The Garrison Dam reservoir holds 23,000,000 acre-feet of water. T. W. MERMEL

See also **DAM**; **MISSOURI RIVER BASIN PROJECT**.

GARROTE, *guh ROHT*, or *guh RAHT*, is an iron collar. It was once used in Spain and Portugal to execute condemned persons. Executioners seated the prisoner in a chair and placed the garrote around his neck. The garrote, attached to an iron post which stood behind the prisoner's chair, was tightened by a screw until the prisoner strangled. Murderers have often used a form of garrote made of loops of wire, or even scarves to strangle their victims.

MARVIN E. WOLFGANG

GARTER, ORDER OF THE, is the highest and perhaps the oldest order of knighthood in Great Britain. An old story tells that while King Edward III of England was dancing with the Countess of Salisbury at a great court ball, she lost her garter. As the King picked it up to hand it to her, he saw several persons smile and indulge in remarks. This made him angry, and he exclaimed in French, "Evil be to him who evil thinks." Then he

The Insignia of the Order of the Garter include the blue garter, the ribbon, the George Star, and the collar.

British Information Services



GARTER SNAKE

added that he would make the little blue garter "so glorious that everyone would wish to wear it." Whether this is true or not, the order was founded by King Edward in 1349. Only 25 members besides the king were first admitted.

The emblem of the order is a dark blue garter edged in gold, on which are printed the words the king spoke, *Honi soit qui mal y pense*. On all ceremonial occasions, the garter is worn on the left leg below the knee.

The order was reorganized in 1831, and the membership was increased to include the Prince of Wales, descendants of George I, and some foreign rulers. The English monarch is always Grand Master. The order has several patron saints, but Saint George was considered its special patron, and it is sometimes spoken of as "The Order of Saint George."

MARION F. LANSING

GARTER SNAKE is the most familiar of all harmless snakes that live in the United States. The nine native species vary greatly in color. Every state in the United States has at least one kind of garter snake. These snakes also live in southern Canada, Mexico, and Central America. It is easy to recognize most garter snakes by the three light stripes that run along the body. One runs down the middle of the back, and the others are on each side near the belly. In many species, a pattern like a checkerboard fills the spaces between the stripes.

The various kinds of garter snakes differ in size. Grown females are usually 20 to 30 inches long, whereas males are a few inches shorter and much thinner.

Three things make garter snakes different from many other American snakes. (1) They like to live in the parks of cities and towns. In the spring and warm autumn when snakes are most active, many people in the suburbs find them in back yards and gardens. (2) Garter snakes bear their young alive instead of laying eggs. The size of a litter varies, but the average is 18. Records show one brood of 80. (3) Garter snakes catch and eat other cold-blooded animals like frogs, salamanders, and fishes. The young snakes of some kinds like to eat earthworms.

Scientific Classification. Garter snakes belong to the family *Colubridae*. The common garter snake is genus *Thamnophis*, species *sirtalis*.

CLIFFORD H. POPE

See also SNAKE (color pictures, Eastern Ribbon Snake, Garter Snake and Young).

GARTH. See CLOISTER.

GARY, Ind. (pop. 178,320; alt. 590 ft.), is one of the most important steel centers of the world. The city was planned in 1905 and rapidly built by the United States Steel Corporation. It is the youngest city of its size in the United States.

Gary lies on the southern shore of Lake Michigan about 30 miles southeast of downtown Chicago. Smoke from the mills of Gary often forms thick clouds above the city by day. The mills light the sky with a red glare at night. Gary, together with Hammond, East Chicago, and Whiting, makes up the Calumet District, one of the greatest of all steel centers. For location, see INDIANA (color map).

Cultural Life. Gary's population includes many foreigners and first-generation Americans, especially persons of Slavic descent. About 30 of every 100 persons in the city are Negroes. Gary's school system was designed to serve the needs of people of many different origins, and it has become widely known for its excellence. The Gary School Plan, a work-study-play combination, is world famous. William Wirt, Gary's first superintendent of schools, developed the plan (see PLATOON SCHOOL). Gary has many parks, all connected by boulevards. The huge Indiana Dunes State Park is 15 miles east of Gary.

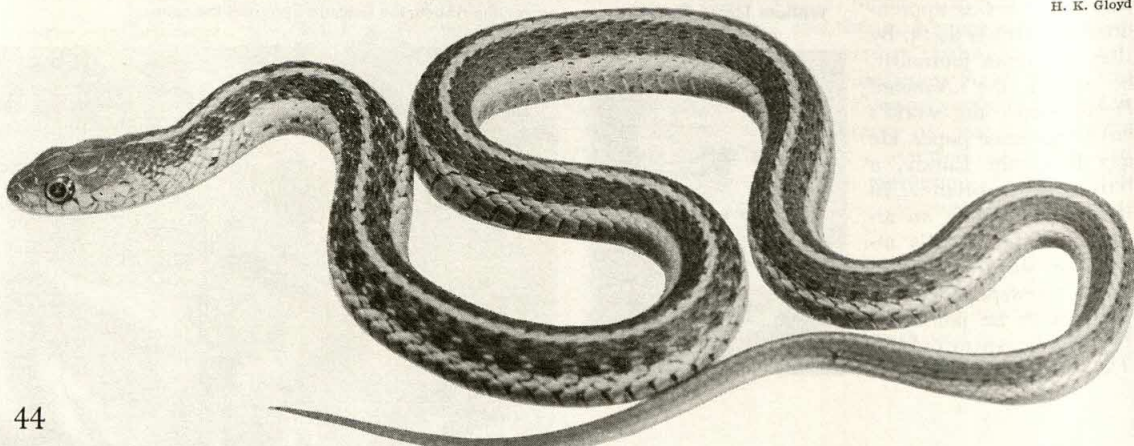
Industry and Commerce. The giant mills of the U.S. Steel Corporation lie along the lake, and about 30,000 workers pass through the entrances to the plants each day. The mills and their branch plants manufacture a vast amount of sheet steel, tin plate, coke, gas, cement, huge numbers of steel rails, and bridges. The coke plant in Gary uses about 600,000 tons of coal a month. Other factories in Gary make hosiery, windshield wipers, bedding, and mattresses.

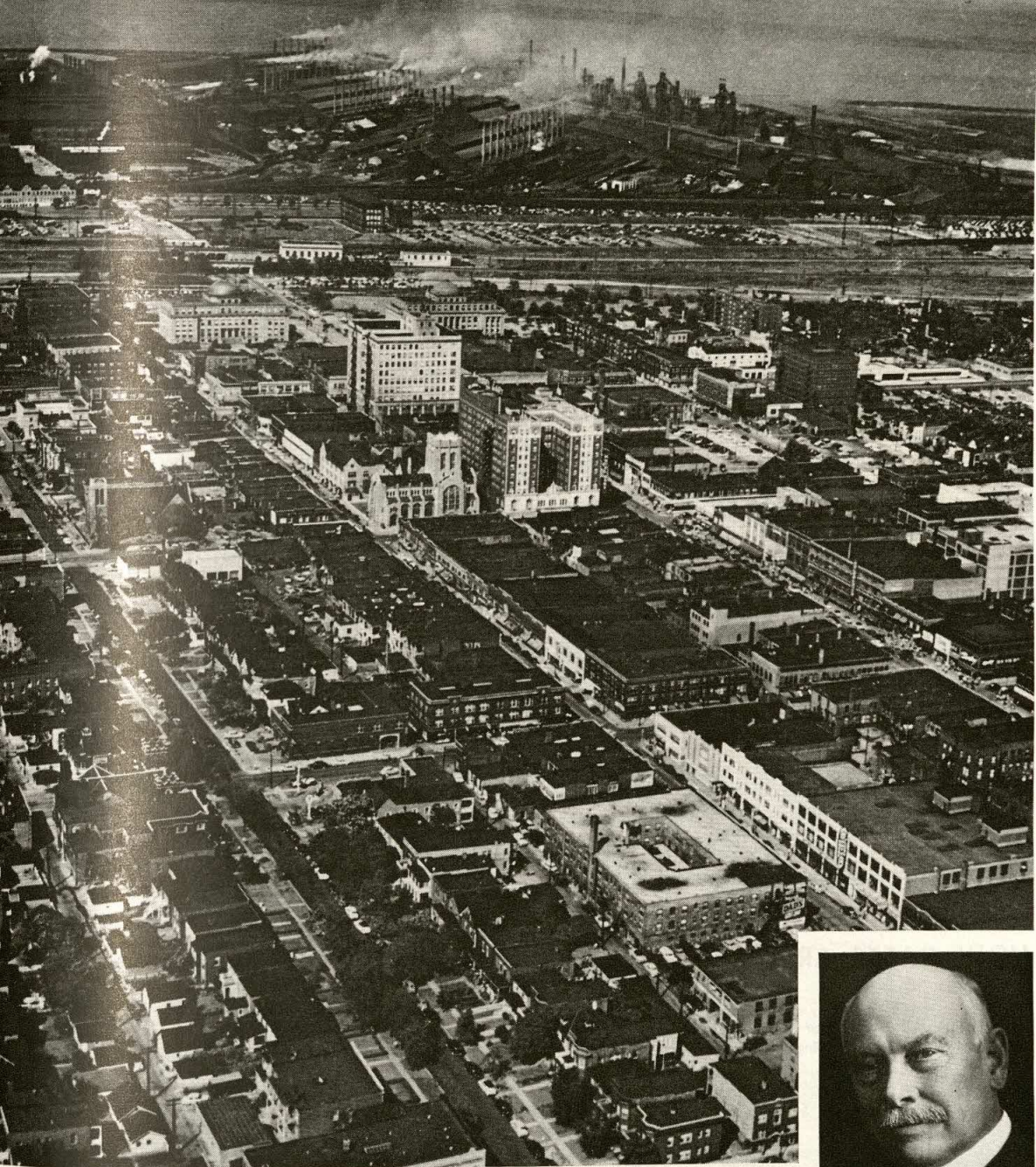
Transportation. Gary is close enough to Chicago for shippers to use the many railroads that have terminals in Chicago. Many products can be shipped eastward directly from Gary. The city is also a large truck freight center. The U.S. Steel Corporation owns the Gary harbor and uses it mainly for ore shipments. Bus and rail lines link Gary and Chicago.

History. The site of Gary was chosen for the main plant of the U.S. Steel Corporation for several reasons. These included the excellent transportation facilities already there and the location midway between the ore supplies of the northwest and the coal fields to the south. Gary was named for Judge Elbert H. Gary, chairman of the board of directors of the U.S. Steel Corpo-

Graceful and Harmless Garter Snakes Like to Live in Vegetable Gardens and Parks.

H. K. Gloyd





Paul Vincent; U.S. Steel

The Giant Steel Mills of Gary, Ind., line the Lake Michigan waterfront, *background*. The city was named for Elbert H. Gary, *right*, a founder of the U.S. Steel Corp.



ration. The wastelands of sand dunes and marshes were quickly transformed into an industrial city. By 1910, Gary had a population of 16,802. Gary has a mayor-council form of government.

PAUL E. MILLION, JR.

See also GARY, ELBERT H.; UNITED STATES STEEL CORPORATION.

GARY, ELBERT HENRY (1846-1927), a steel industrialist and lawyer, helped organize the United States Steel Corporation in 1901. He became chairman of its finance committee and chairman of the board of direc-

tors. He also took a leading part in organizing the Consolidated Steel & Wire Company, American Steel & Wire Company, and Federal Steel Wire Company. He was the first president of Federal Steel, which was formed in 1898. The steel manufacturing city of Gary, Ind., was named for him. Gary was born in Wheaton, Ill. He received a law degree from the University of Chicago in 1867. His career began in the superior-court office in Chicago, and he later became chief counsel for several railroad and steel companies.

HAROLD F. WILLIAMSON

GAS

GAS. Matter has different forms, *solid*, like a stone; *liquid*, like water; and *gaseous*, like air. Gas is the lightest, thinnest, and most movable form of matter that we know. Gases pass through each other much more easily than the other forms of matter do. This quality is called *diffusion*, and gases are the most diffuse form of matter.

Characteristics of Gases

A gas will fill up any vessel that holds it, and usually has no shape of its own. A liquid that half fills a jar has a top surface of its own, but a gas has none. On the other hand, an amount of gas with a certain weight can fill up a larger or a smaller space. Gases are very light compared with liquids and solids. Air is nearly 800 times as light as water. Hydrogen, the lightest gas, is about $14\frac{1}{2}$ times as light as air. Gas can be compressed into a small space better than the other forms of matter, and easily expands into a large space.

Composition. Most scientists agree that the behavior of gases can be explained by the *kinetic theory of gases*. This theory says that all objects are made of millions of tiny moving particles called *molecules*. Molecules are much too small to see. A volume of gas as large as the head of a pin would contain thirty million times as many molecules as there are people on earth. These molecules may be compared to tiny rubber balls flying hither and thither, jostling one another and striking and bouncing from the sides of any vessel or room. The result of this bombardment of tiny blows is what we call *gaseous pressure*.

The molecules that make up a gas are more active and farther apart than molecules of the other forms. This explains the easier diffusion, the shapelessness, and the great compressibility of gases. Gases and liquids are both known to scientists as *fluids*. They flow, diffuse, and take on the shape of their containers more readily than solids.

Color and Odor. Many gases, like oxygen, hydrogen, nitrogen, and carbon dioxide, have neither color nor odor. We know they are present only by the things they do to us or to a substance placed in them. Other gases have colors and odors, and it is not hard to recognize them. Nitrogen dioxide is a brown gas. Chlorine is yellowish green, and has a strong, unpleasant odor. Hydrogen sulfide is the gas that gives the foul odor to sewer gas and rotten eggs.

Weight. Although gases are often invisible, tasteless, and odorless, they have weight. Everybody has felt the push of air when the wind blows. Its force is often great enough to fell trees and sweep the masts from ships in storms at sea. The pressure of the air, which is the force of its weight, is what holds up the column of mercury in the mercury barometer.

Changing Gases

Early scientists thought that the substances that were gases never turned into any other forms of matter. Michael Faraday, between 1823 and 1845, showed that this was not true. He changed most of the well-known gases to liquids by cooling and compressing them. In 1869, it was shown that carbon dioxide cannot be changed to a liquid if its temperature is above 88° F. (31°C.). But at that temperature or below it, only moderate pressure is needed to liquefy the gas. This temperature is called the *critical temperature*. It has since been found that each gas has its own critical temperature, above which it cannot be liquefied by pressure.

Faraday and other scientists of his time failed to liquefy oxygen, nitrogen, hydrogen, and carbon monoxide. These gases have lower critical temperatures than scientists could produce at that time. Methods invented since then have succeeded in producing much lower temperatures and liquefying all gases.

Solids and liquids can also be changed into gases by heating them or lowering their pressure. If a substance is solid or liquid at everyday temperatures, its gaseous

HOW GASES ARE USED

Gases serve man in a variety of useful ways. Natural gas, for example, forms one of the most valuable fuels. Carbon dioxide makes sparkling bubbles in beverages.



Norge



NITROUS OXIDE
Anesthetic

NATURAL GAS
Cooking and Heating

U.S. Airforce



HELIUM Balloons and Airships

form is usually called *vapor*. *Steam* is hot *water vapor*, the gaseous form of water. We usually call a substance a gas if that is the form it has at everyday temperatures.

Laws of Gases

Boyle's Law. Robert Boyle, a scientist who lived in the 1600's, noticed that when a gas was forced into a smaller space, the pressure increased. He announced that the smaller the space the greater the pressure, if the temperature of the gas is kept the same.

He also found that the pressure is in direct proportion to the density of the gas. This means that when the pressure upon the gas from the outside is increased four times, the gas is packed into one fourth its original space, and its own push against the walls of its container is four times as great as it was. It is easy to see why this is so. If the same number of molecules is packed into a smaller space, more molecules will hit the side of the vessel than would hit an equal part of the larger vessel. Boyle's Law is sometimes called *Mariotte's Law* after Edme Mariotte, a French physicist who made the same discovery independently of Boyle.

Charles' Law. Heating a gas gives energy to its molecules, so that they strike the sides of the vessel more rapidly. This means that the gas in the vessel is exerting a greater pressure. If the walls are movable the gas will push them out. When this happens, we say the gas expands with heat, just as nearly all other substances do.

The French scientist, Jacques Charles, stated that with each degree that the temperature rises, a gas will expand by the same fraction of its original volume. This is true only if the pressure is kept the same. If the temperature is in degrees centigrade, this fraction, which is called a constant, is $\frac{1}{273}$ of the volume at 0°C.

Avogadro's Law. Molecules are so tiny and light that it would seem impossible to weigh a single one. But we can figure out the weight of a molecule of many substances with the help of Avogadro's law. In 1811, Amedeo Avogadro, an Italian scientist, first suggested that

when equal volumes of different gases and vapors are put under the same pressure at the same temperature, they have the same number of molecules. For many years scientists were not sure this statement was true, but they now believe they have proved it is a natural law.

If we can weigh a volume of gas and find out the number of molecules in it, we ought to be able to calculate the weight of one molecule. It has been found that in 22.4 liters of any gas at standard conditions (0°C. and 760 millimeters pressure) there are 602,000,000,000,000,000,000, or 6.02×10^{23} molecules. This is called *Avogadro's number*.

GEORGE L. BUSH

Related Articles in WORLD BOOK include:

BIOGRAPHIES

Avogadro, Amedeo
Boyle, Robert

Faraday, Michael
Gay-Lussac, Joseph Louis

GASES

Acetylene
Air
Ammonia
Argon
Atmosphere
Carbon Dioxide
Carbon Monoxide
Chlorine
Coal Gas
Cyanogen
Damp

Ethane
Fluorine
Formaldehyde
Gas (fuel)
Helium
Hydrogen
Hydrogen Bromide
Hydrogen Iodide
Hydrogen Sulfide
Krypton

Methane
Neon
Nitrogen
Nitrous Oxide
Oxygen
Ozone
Radon
Steam
Vapor
Xenon

PROCESSES

Condensation
Diffusion

Distillation
Evaporation

Expansion

UNCLASSIFIED

Airship
Balloon
Barometer
Boiling Point
Chemistry

Dalton's Law of
Partial Pressure
Fuel
Gas Mask
Hydrostatics

Lethal Chamber
Matter
Pneumatics
Pressure
Will-o'-the-Wisp

H. Armstrong Roberts

CARBON DIOXIDE

Fire Fighting



Liquid Carbonic Div. of
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Beverages

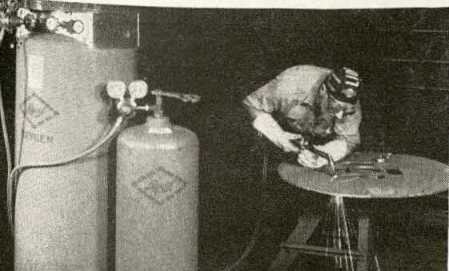


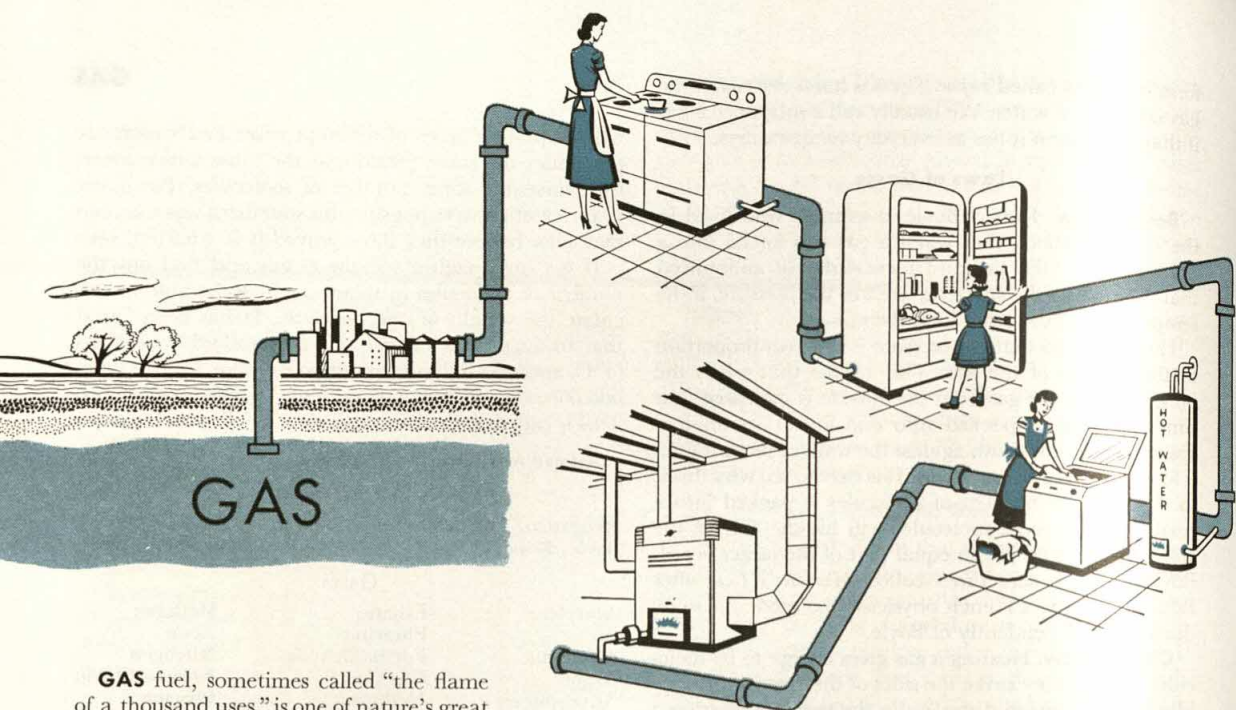
Life Rafts



ACETYLENE

Cutting and Welding





GAS fuel, sometimes called “the flame of a thousand uses,” is one of nature’s great gifts to man. Its clean, blue flame is used in millions of homes for cooking, for heating, and for refrigeration. Gas also is used in many important ways in industry.

Most of the gas fuel we use is natural gas. This kind of gas might well be called “stored sunshine.” It was formed long ages ago by the combined action of sunlight and earth movements. Today, well drillers find it stored in sands and rock layers far underground. Pipelines carry it as far as two thousand miles to homes and factories where it is needed.

Natural gas is most familiar to us as a fuel, and that is its most important use. But it is the source of many valuable chemicals as well. Natural gas chemicals are used in making plastics, medicines, rayon, fertilizers, and hundreds of other products.

One out of every ten gallons of gasoline we use in our automobiles is taken from natural gas. The rubber tires on which we ride wear longer because natural gas and natural gas materials were used in making them. The steel springs that carry us smoothly over bumps were tempered with natural gas heat to make them strong.

After natural gas is brought to the surface, it needs only to be purified before it is ready for use. But tiny particles, or *molecules*, of gas also are found locked up in every lump of coal and every drop of petroleum. Heat and chemical processes release these molecules from the coal and oil and produce *manufactured gas*, an important fuel. Sometimes manufactured gas is mixed with natural gas before it is burned. Natural and manufactured gas furnish us with a large proportion of our fuel. Natural gas alone supplies about 28 per cent of all the fuel energy produced in the United States, and one sixth of that produced in North America.

How Man Learned to Use Gas

Early Uses. Long ago, a shepherd of Greece noticed that his sheep acted strangely when they came to a certain place on the mountainside. He and his neighbors investigated and found that something came from the

ground which made them light-headed and talkative. The story grew up that these escaping natural gas vapors were the breath of the god Apollo. A temple was built at the place, which was named Delphi. This temple soon became the religious center of all Greece. A woman prophet, or *oracle*, sat on a tripod amid the fumes. She answered questions which people brought to the temple. People supposed that the words she uttered actually were spoken by the god Apollo. Because of the way in which priests interpreted her sayings, the oracle at Delphi became a power in the political and social affairs of the Greeks.

Several ancient peoples learned that natural gas would burn. The Chinese were the first to use this fuel for industrial purposes. Nearly three thousand years ago they obtained gas from wells 2,000 feet deep, sent it through bamboo pipes, and used it to evaporate brine for making salt. Gas wells were known in Japan as early as A.D. 615. Natural gas was known and used also in India, Persia, and various countries of Europe.

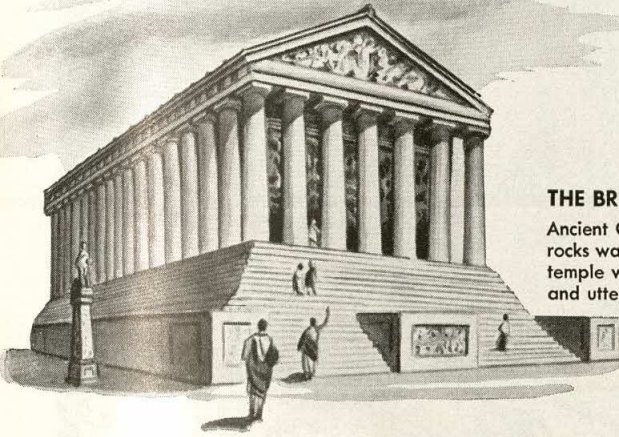
During the early 600’s A.D., temples were erected over natural gas deposits near Baku (now in the Soviet Union) on the Caspian Sea. Fire worshipers from Persia and India made pilgrimages to the shrines. One temple was in use as late as 1880. When the building was torn down about 1900, a secret pipe was found which carried natural gas from a crack in the rock to the altar where the “eternal flame” was kept burning.

Discovery of Manufactured Gas. The manufacture of gas dates back to the early 1600’s. Jan Baptista van Helmont (1577-1644) is given credit for producing the first manufactured gas from coal in Brussels, Belgium. He was an alchemist, and was trying to make gold at the time that he discovered manufactured gas. Van Helmont called the gas he created by accident a “ghost” or “wild spirit.” Some students say the word *gas* came from the Dutch word *geest*, which means *spirit*.

GAS—THE MAGIC FLAME THAT WORKS FOR MAN

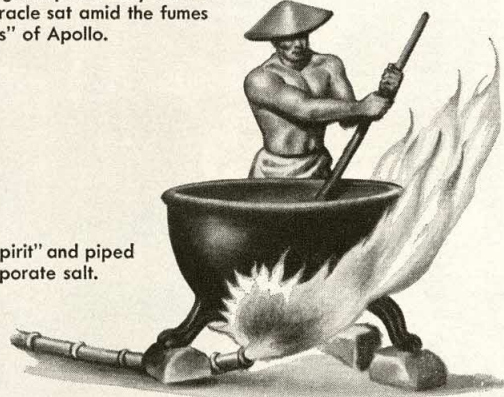
THE BREATH OF APOLLO

Ancient Greeks believed natural gas escaping from rocks was the breath of the god Apollo. They built a temple where the Delphic oracle sat amid the fumes and uttered the "prophecies" of Apollo.



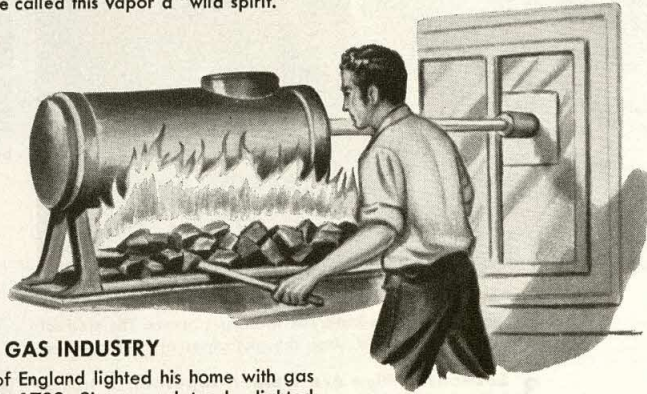
FIRST INDUSTRIAL USE OF GAS

The Chinese of ancient times found a "burning spirit" and piped it in bamboo lines to their brine wells, to evaporate salt.



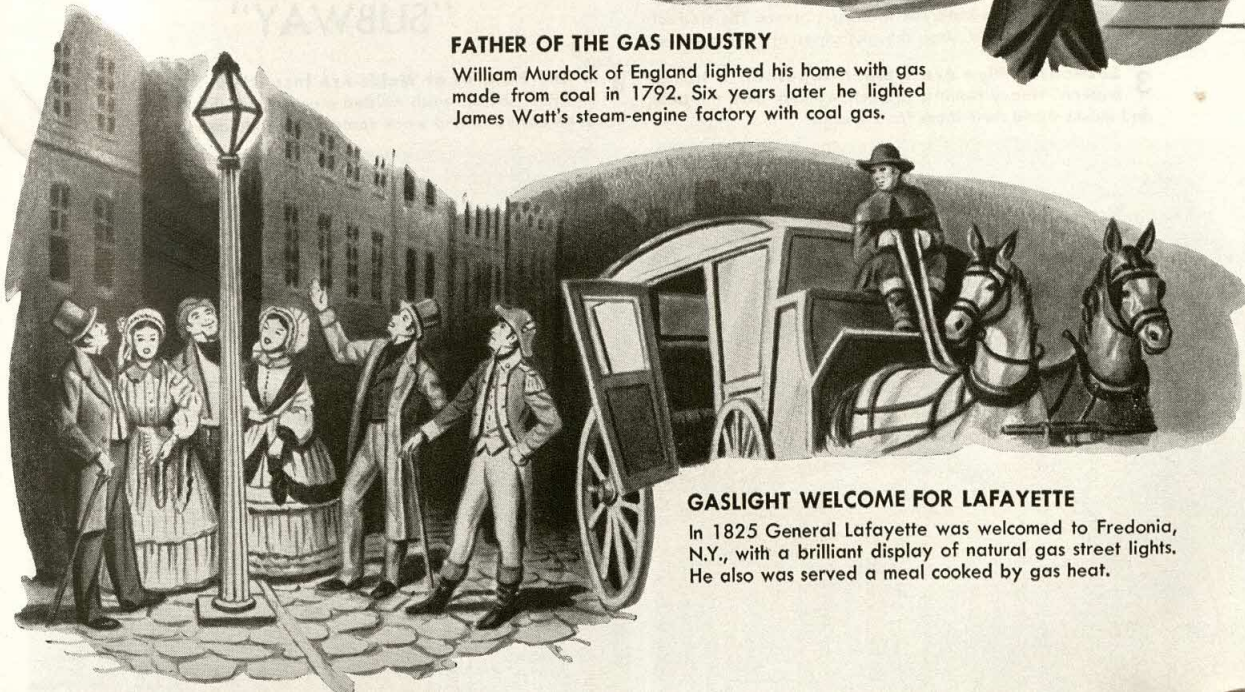
A "WILD SPIRIT" FROM COAL

In 1609, a Belgian scholar named Jan Baptista van Helmont heated coal and learned that it gave off a vapor, or gas, which would burn. He called this vapor a "wild spirit."



FATHER OF THE GAS INDUSTRY

William Murdock of England lighted his home with gas made from coal in 1792. Six years later he lighted James Watt's steam-engine factory with coal gas.



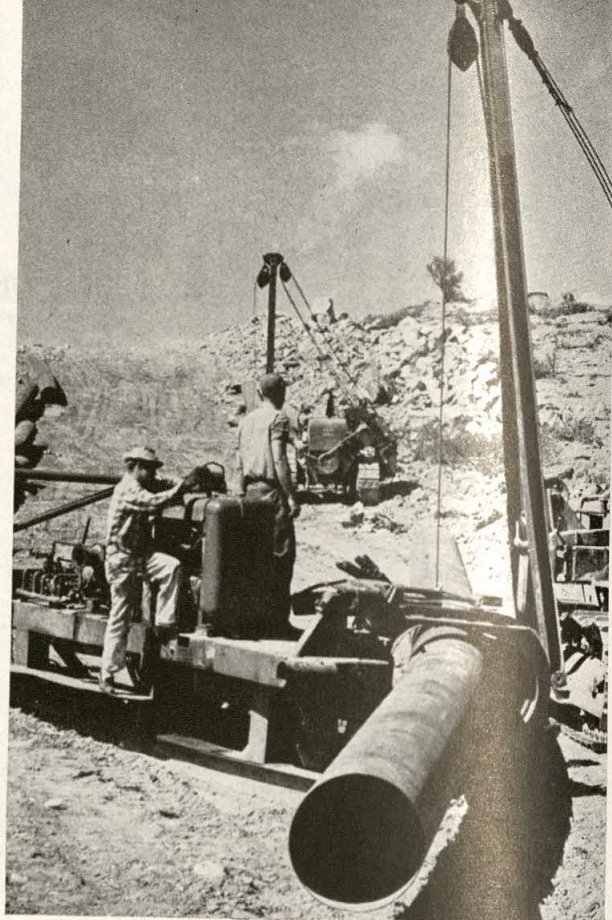
GASLIGHT WELCOME FOR LAFAYETTE

In 1825 General Lafayette was welcomed to Fredonia, N.Y., with a brilliant display of natural gas street lights. He also was served a meal cooked by gas heat.



1 "Big Mucker" Digs Trench for Pipe Line that will carry natural gas hundreds of miles to users. The six-foot trench will be covered when the gas pipes are set in place.

3 Sections of Pipe Are Welded Together by trained workers. Heavy clothing protects workers from the heat, and masks shield their faces from sparks.



For LIFE by Bernard Hoffman (c) TIME, Inc.; Peoples Gas of Chicago; Amer. Gas Assn.

2 Pipe Is Bent to Fit the Lay of the Land. A surveyor first figures out the angle at which each section of steel pipe must be bent. Then this powerful machine goes to work.

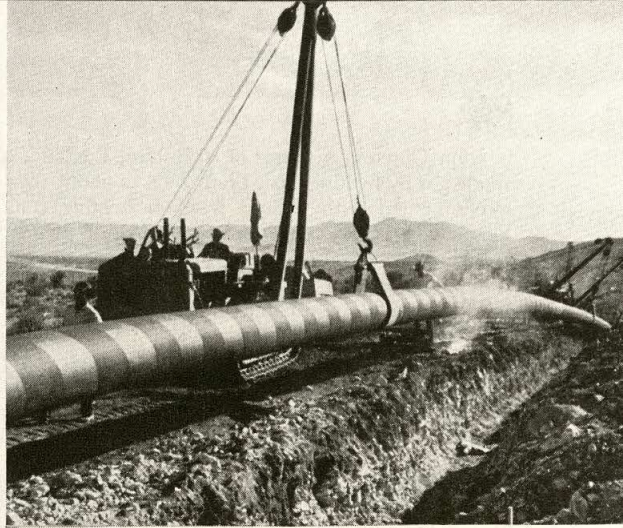
GAS RIDES A THOUSAND-MILE "SUBWAY"

4 X-Ray Pictures of Welds Are Inspected. A portable X-ray machine "shoots" each welded place in the pipe. The developed film is examined to find weak spots that might cause leaks.

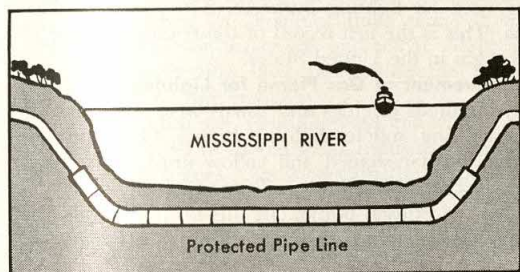




5 Automatic Machine "Dopes and Wraps" Pipe to protect it from rust and from acids in the earth. "Dope" is a coat of enamel. "Wrap" is a tightly-wound layer of paper or other fiber.



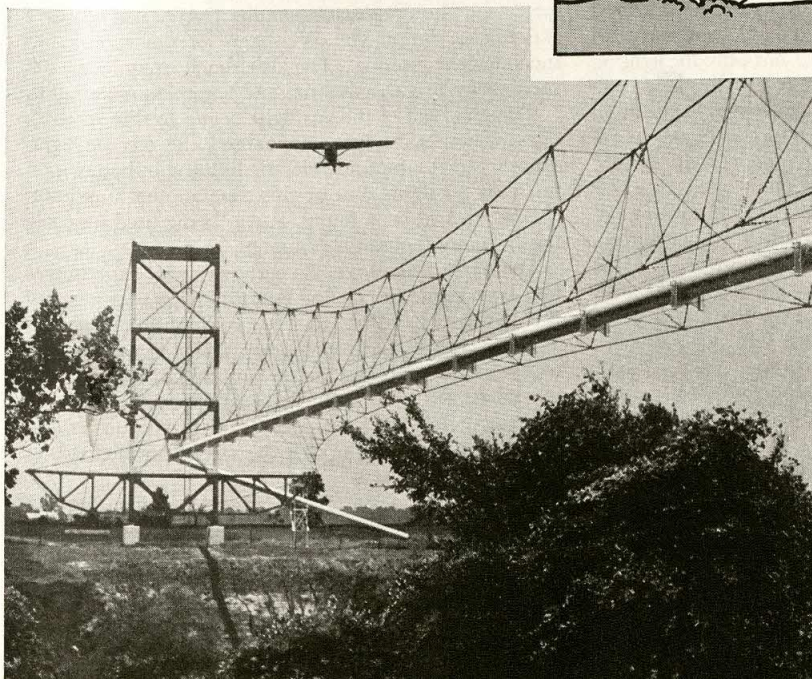
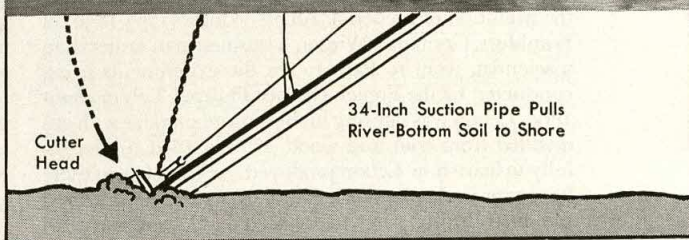
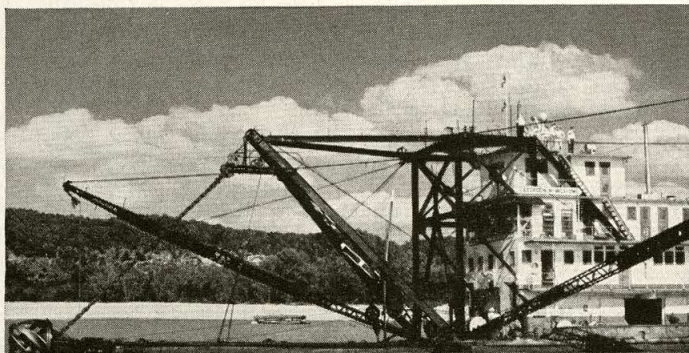
6 Side-Boom Tractors Pick Up Pipe and Lay It in Trench. These tractors with cranes do all handling of pipe, which may weigh 1½ tons to each 30-foot section. Other machines cover the pipe.



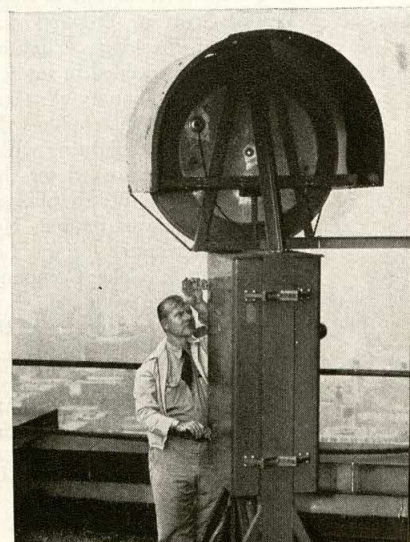
7 How Pipeline Crosses the Mississippi River. The pipe is heavily wrapped for protection, and placed in a trench a safe depth under the river bottom.

8 Dredge Cuts Shore-to-Shore Channel into which pipe is lowered. One 3,000-foot Mississippi crossing required the removal of 2,000,000 cubic yards of mud.

9 Pipeline Leaps Some Rivers and Gorges on its own suspension bridges. Inspector in plane flies up and down line looking for leaks or damage.



10 Operating Orders Are Flashed to any point along line by microwave relay system.



John Clayton, a pastor of Yorkshire, England, also made gas by heating coal. From 1660 to about 1670 he experimented with various ways of heating coal in closed vessels and then burning the "spirit" which resulted. He amused his friends by collecting the gas in animal bladders, puncturing them, and lighting with a candle the gas that came out.

Progress in the use of gas was slow. A French scientist, Antoine Laurent Lavoisier, experimented with gas in an effort to find a way of lighting large cities. About 1780 he invented a gas holder. This replaced the bladders which previous experimenters had used to collect the gas.

But homes were still lighted with wax and tallow candles late in the 1700's. It was not until 1792 that a British engineer, William Murdock, put coal gas to work in the home. He heated coal in an iron vessel, or retort, and conducted the gas through seventy feet of tin and copper tubes to light his home in Cornwall, England. Murdock also is credited with discovering the principle of letting gas flow out through tiny holes, or *orifices*. This gives a better mixture of air and improves the quality of the gas flame.

Murdock worked as an engineer for James Watt, developer of the steam engine, in his experiments with manufactured gas. By 1798 Murdock had progressed to the point where he built large-scale gas-making apparatus and lighted a factory of Boulton, Watt & Company with gas. In 1804 he built a gas works and lighted a cotton mill at Manchester with nine hundred gas burners. For this achievement the Royal Society of London awarded him a gold medal in 1808.

The work of Murdock and other scientists came to the attention of Frederick Albert Winsor (1763-1830) of Frankfurt, Germany. Winsor, a businessman rather than a scientist, went to Paris to see the experiments being conducted by the French chemist Philippe Lebon about 1800. Lebon was lighting his home and gardens with gas distilled from coal and wood. Winsor tried unsuccessfully to learn how Lebon produced the gas. He was more fortunate in England. On May 18, 1804, he obtained the first British patent for gas-making purposes. He foresaw the widespread use of gas not only for lighting but also for heating homes and for cooking food.

Winsor had to fight prejudice, fear, and superstition to get his ideas accepted. Such national figures as Sir Walter Scott in England and Napoleon in France scoffed at his idea of lighting cities with "smoke." Finally he succeeded in interesting several investors in his plans. On January 28, 1807, with the backing of a large group of shareholders, his company staged the first public street lighting with gas along Pall Mall in London. Winsor asked for the exclusive privilege of lighting all the British possessions with gas, but this broad charter was refused. However, in 1822 Winsor obtained a charter for the London and Westminster Gas Light & Coke Company. It was the first gas company in the world.

Early Developments in the United States. The earliest known discovery of natural gas in the United States was in 1775, when a pioneer found a "burning spring" in what is now Kanawha County, West Virginia. Two years later George Washington claimed the "burning

spring" land. Gas seepages also were found along Lake Erie and in various other places, and pioneer children delighted in setting fire to them and watching them burn.

The first practical use of gas in the United States was of manufactured gas rather than natural gas. In 1806 David Melville of Newport, R.I., lighted his home and the street in front of his house with gas manufactured from coal. He also lighted a factory at Pawtucket and made a contract with the United States Government to supply gas for a lighthouse at Beaver Tail in Rhode Island. In 1816, Baltimore became the first city in the United States to light its streets with manufactured gas. Rembrandt Peale and his associates formed the first gas company in the United States to light the city.

Meanwhile, natural gas was discovered as early as 1815 during the digging of a salt brine well at Charleston, W. Va. Six years later, the first commercial natural gas well was drilled to a depth of twenty-seven feet at Fredonia, N.Y. By 1824 the gas from this well was being used for lighting purposes in the town of Fredonia. This is the first record of the commercial use of *natural gas* in the United States.

Improvement of Gas Flame for Lighting. By about 1850, hundreds of cities and towns were using gas for street lighting and for lighting homes. Gas flame for lighting was fan-shaped and yellow until about 1855, when Robert Wilhelm von Bunsen of Germany developed the Bunsen burner. In this burner the air and the gas were premixed for proper burning, or *combustion*. The flame was adjustable, ranging from a yellow flame containing carbon particles to a hot blue flame that was smokeless and free of soot. The present Bunsen burner works on the same principles. See BUNSEN BURNER.

Carl Auer, a student of Bunsen, made another great improvement in gas lighting. He developed a *gas mantle*. This was a lacelike hood, made of a heat-resisting material, which was placed in position over the flame. Auer made his mantle of cloth dipped in the salts of the elements thorium and cerium. When the Bunsen flame played upon the mantle it gave off a great white-hot, or *incandescent*, light. Auer was awarded the title of Baron von Welsbach for developing this incandescent mantle. The Welsbach mantle is still used today in gas, gasoline, and some kerosene lights.

The great era of the gas light began to dim in 1879, when Thomas A. Edison invented the electric light. Electric street lamps and electric lighting in homes soon replaced gas lights. But by this time another important use for gas had been found. It was being used for cooking in many thousands of homes.

The Early Gas Stove. As early as 1739, experiments had been made in cooking eggs or chops over gas jets. But it was not until 1832 that an Englishman named James Sharp actually demonstrated a stove designed to use gas for cooking. Some time after 1840 the first gas range was built in the United States. It consisted of an iron ring filled with sand and placed on an iron screen. Gas was fed through the screen and lighted on top of the sand.

By 1859 only about one hundred American families were using gas ranges for cooking. But several different types of gas ranges were exhibited at the Centennial Exposition at Philadelphia in 1876. The first gas stoves

having oven heat regulators, or *thermostats*, were placed on the market in 1915.

Growth of the Modern Gas Industry. Natural gas as it came from the ground sometimes had a very bad smell that made it unpopular as a fuel. In their efforts to remove this smell, and through other research, scientists found that natural gas contained valuable chemicals (see *Products of Natural Gas* in this article). This was the beginning of one of the most important branches of the chemical industry.

The development of pipelines stimulated the use of both natural and manufactured gas as a fuel. The pipelines were made first of wood, and later of iron, lead, wood and concrete, and steel. See PIPELINE.

Natural gas often is found with petroleum. For many years the gas was considered a waste material that interfered with getting the oil. It was a common sight to see this waste, or *casinghead*, gas being burned at mouths of wells, or being blown into the air at the oil fields. However, the growth of markets for natural gas and the building of pipelines have made it worth while to gather the waste gas and sell it. States have adopted conservation laws prohibiting the waste of this valuable natural resource.

Today, natural gas, manufactured gas, or a mixture of the two is used in thousands of industrial plants and in millions of homes. Gas is used in the home to give seven major services. These are cooking, water heating, refrigeration, house heating, air conditioning, laundry drying, and the burning of waste in incinerators.

Large amounts of gas still are made from coal, coke, and petroleum. But four fifths of all the gas used is natural gas. In a single year the United States uses over nine million million, or *nine trillion*, cubic feet of natural gas. Canada uses about seventy-four billion cubic feet of natural gas a year. When we realize that the twenty-gallon tank on an automobile holds only about two and two-thirds cubic feet of gasoline we can get some idea of the tremendous volume of natural gas used each year.

Natural Gas

How Natural Gas Was Formed. The exact origin of natural gas is not known. But most geologists and chemists agree that it was created through chemical action on tiny plants and animals that lived, died, and were buried ages ago. Billions upon billions of these little plants and animals lived on the shores of water that covered a large part of the earth's surface. They fed upon little except water and sunshine. Great numbers of these tiny living things sank or were washed into the ancient seas. In time they formed an ooze hundreds of feet deep called *organic sediment*. Explosions and upheavals on the surface of the young earth brought down layers of rock which covered the ooze.

Under heat and pressure the organic sediment fermented and decayed, forming gas and oil. In some places the movements of the earth's crust lifted up the organic sediment. But in other places they buried the layers of sediment hundreds and thousands of feet beneath the surface. The gas and oil seeped through deposits made of limestone, sandstone, and other porous rock. Hard layers of rock above these sand deposits have kept the gas and oil from leaking out. The gas in the earth usually is sealed under great pressure,

so that when it is tapped it comes roaring to the surface with hundreds of pounds of pressure behind it. Sometimes it is also hot. It is not uncommon for natural gas to have a temperature of 150 or 200 degrees Fahrenheit when it reaches the surface.

Products of Natural Gas. We usually think of natural gas as a fuel. It is equally important, however, as the source of raw materials for the chemical industry. For several years past, natural gas and petroleum have accounted for the production of almost half the valuable organic chemicals which were formerly produced by fermenting sugar. The valuable chemicals are taken out of natural gas before it is piped to consumers.

Chemicals from natural gas are used in making products of all kinds. These range from ink to synthetic rubber, from explosives to perfume, and from antifreeze to drugs and dyes. Much of the LP, or liquefied petroleum gas, which is used for heating and cooking in homes beyond the gas mains, is taken from natural gas (see *Liquefied Petroleum Gas* in this article). Alcohols, solvents, and anesthetics are made from natural gas. A newly developed method called the *hydrocol* process is used for converting natural gas into automobile gasoline and into certain oils and waxes. There are more than 25,000 industrial and commercial uses for natural gas in addition to its use as a fuel.

Where Natural Gas Is Found. Natural gas is commonly found near deposits of petroleum or with petroleum. See PETROLEUM.

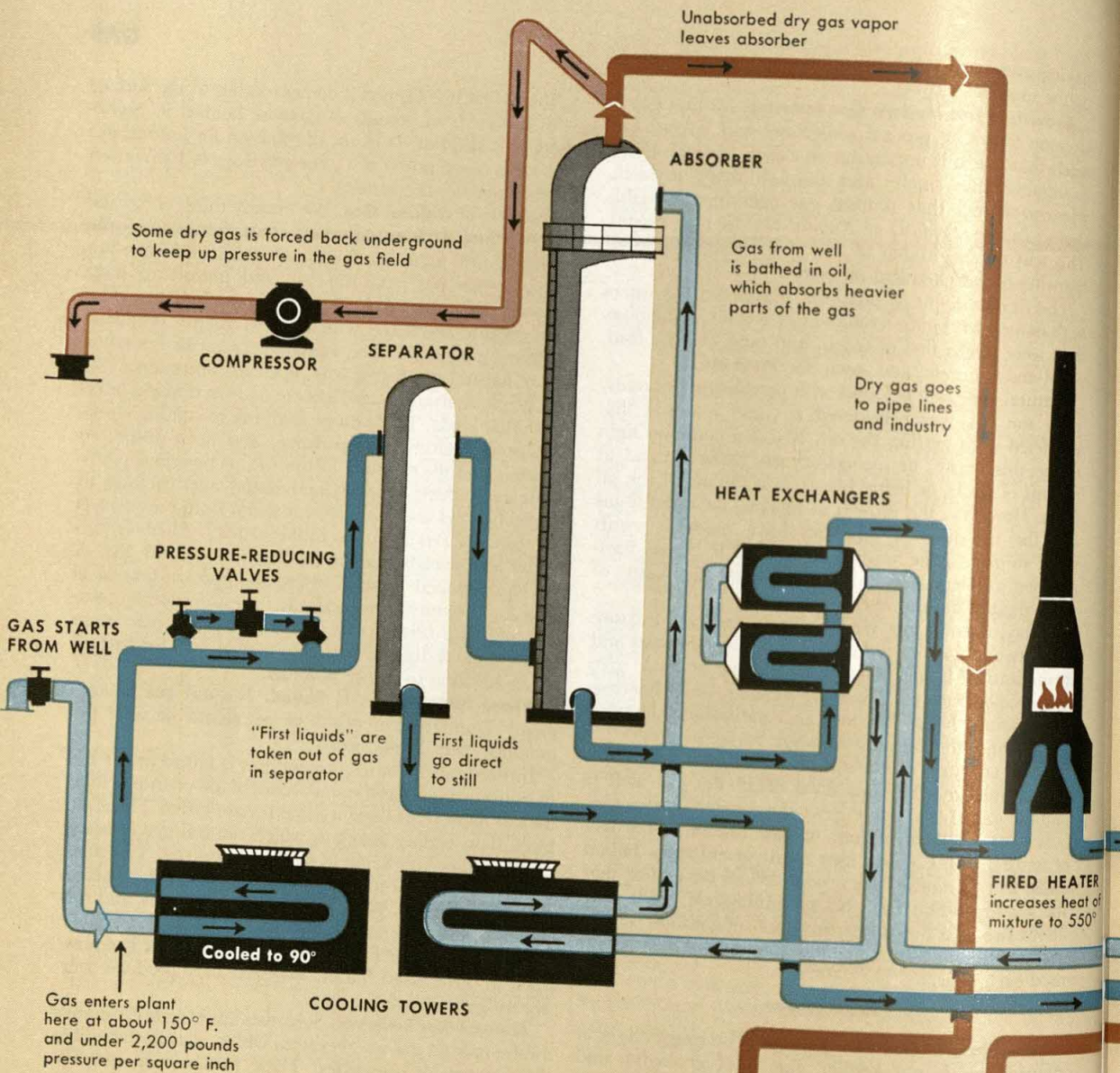
In the United States, natural gas is found under less than twenty thousand square miles of the country's total area of more than three million square miles. There are more than twenty states in which natural gas is being produced and marketed in sizable quantities. The chief producing regions include the Gulf Coast, the Pacific Coast, the Middle West, the Rocky Mountains, and the Appalachian Mountains. Two states, Texas and Louisiana, produce over 60 per cent of the natural gas now used in the United States. Together they produce over six trillion cubic feet a year.

Natural Gas Reserves. Scientists have made estimates of the natural gas reserves from which gas can be taken in commercial quantities. These *proved recoverable reserves* in the United States total nearly 238 trillion cubic feet. The fields covered by this estimate produce more than ten trillion cubic feet each year.

Other areas near the proved natural gas fields are still unexplored to any great extent. An outstanding natural gas authority has estimated that more than five hundred trillion cubic feet of natural gas are still stored in the nation's reserve deposits. Canada has an estimated reserve of eight trillion cubic feet, but has a great number of unexplored potential gas fields.

Exploration and Drilling. The underground pools of gas are capped by layers of dirt and rock, and wells must be drilled to get the natural gas out of the ground.

Geologists are constantly at work exploring areas which contain the kinds of rock formations where natural gas usually is found. A favorable report from a geologist is followed by *wildcat drilling*, as drilling in unproved areas is called. This usually is done by the large producing companies, though independent operators frequently have discovered important natural gas fields.



NATURAL GAS AND ITS PRODUCTS

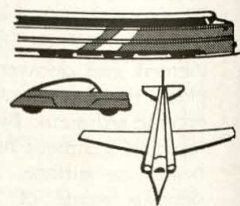
Natural gas contains many valuable chemicals. These are removed in a "cycling plant," as shown in this diagram. Natural-gas chemicals, called hydrocarbons, have many important uses in industry. The "dry gas" that remains after certain hydrocarbons are removed is the common gas fuel used in homes and factories. But dry gas also may be used to make still other products.

DRY GAS (Ethane-Methane)



Fuel for home and industry
Carbon black for ink and rubber
Methyl alcohol for antifreeze
Formaldehyde for plastics, drugs, dyes, embalming fluid

HEAVIER HYDROCARBONS



Jet engine fuel
Diesel fuel
Gasoline
Kerosene

PRIMARY, SECONDARY, and CONDENSATE STILLS

Three stills strip raw gasoline from oil as vapor, then condense it to a liquid

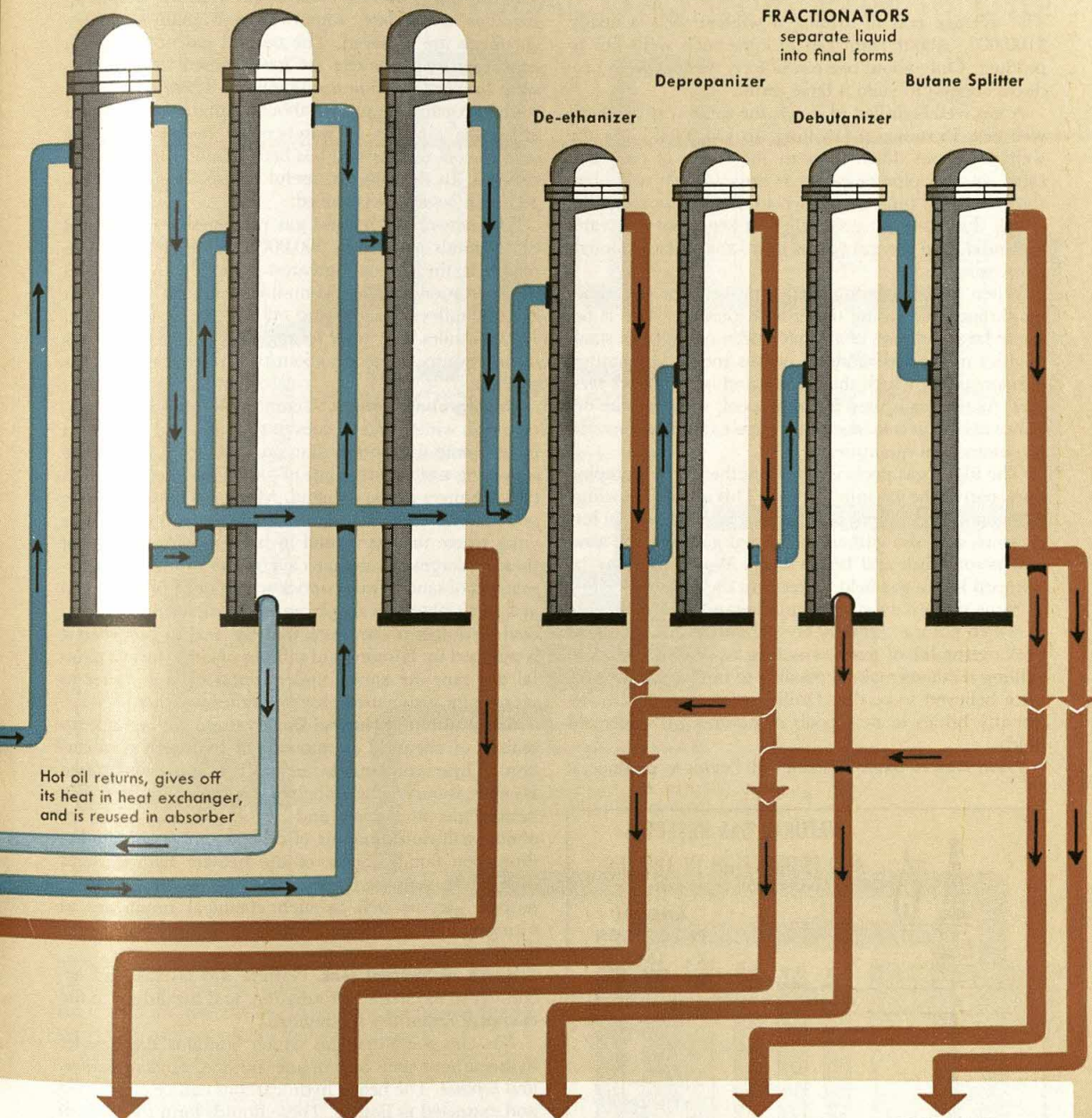
FRACTIONATORS
separate liquid
into final forms

Depropanizer

Butane Splitter

De-ethanizer

Debutanizer



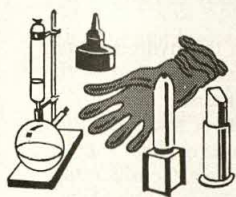
ETHANE-
PROPANE

PROPANE-
BUTANE

NATURAL
GASOLINE

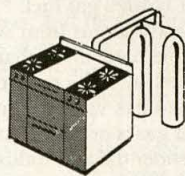
ISOBUTANE

BUTANE

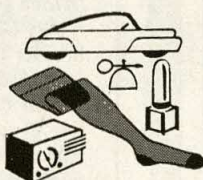


Mustard gas
Vinyl plastics
Ethyl alcohol
Chloroform
Synthetic rubber
Nitroglycerin

Acetic acid
Acetone
Ether
Ink
Antifreeze
Cosmetics



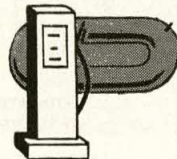
Bottled gas fuel
(liquefied petroleum gases)



Aviation gasoline
Automobile gasoline
Benzene for making nylon
Cleaning fluid
Phenol for plastics, explosives
Toluene for explosives, perfuma



Aviation gasoline
Synthetic rubber



High-grade auto gasoline
Butadiene rubber

GAS

The average cost of drilling a wildcat well is nearly \$100,000. About eight out of nine such wells fail to produce. Only about one out of forty wildcat wells produces enough to yield a large profit.

A gas well is drilled in much the same way as an oil well (see PETROLEUM [Drilling an Oil Well]). As the well progresses down through the layers of rock and sand, an iron pipe or casing is driven down to protect the hole. This pipe goes down to the rock dome under which the gas-bearing sand lies. It keeps out the water and sand, and the gas comes up to the surface through this casing.

When the gas-bearing sand is tapped, the gas rushes up through the casing under high pressure. This is because large volumes of gas have been confined in small cavities in the gas sands or porous rocks. The natural pressure under which the gas is found is called *rock pressure*. As the gas is used from the pool, rock pressure declines until it gets so low that the gas cannot be removed in commercial quantities.

The life of gas pools is often lengthened by pumping back part of the gas into the well. This is called *recycling*. The repumped gas not only forms a cushion against low pressure, but also gathers additional gas from the sand and porous rock and brings it up. Water also may be pumped into a gas field to keep up the pressure.

Some states have strict regulations governing the rate at which natural gas may be withdrawn from pools, to prolong the life of reserves as long as possible. Modern drilling methods make it possible to tap pools that were once believed to be dry. Drilling to greater depths frequently brings in new pools of natural gas under old fields.

From Well to User. When a well begins to produce, it

is capped to prevent the escape of gas. A pipe called the *gathering line* carries the natural gas from the well to an *extraction unit*. Here, impurities and many valuable chemicals are removed. The natural gas now enters a *compressor station*, where the gas is raised to high pressures to speed it along the pipelines. These compressor stations usually are placed about a hundred miles apart along the pipeline. A water-cooled *condenser* may be used to cool the gas that has been heated through compression. In this process, useful chemicals such as *propane* and *butane* are removed.

The network of natural gas pipelines in the United States totals more than 500,000 miles in length. This makes it the nation's greatest privately owned land transportation system. Main-line railroads total over 222,000 miles in length, and oil pipelines extend about 142,000 miles. For every fourteen miles of public roads in the country, there are about two miles of natural gas pipeline.

Underground Storage. A community uses more natural gas in winter than it does in summer, and more on a bitterly cold winter day than on a mild day. A pipeline supplying a steady amount of gas cannot keep up with these changes in the demand. Many gas companies are now storing the precious fuel underground near those cities where the gas is used in large amounts. Some of these underground storage caverns are dry fields, or formations of sand or porous rock which once produced oil and gas. Others are simply natural rock formations covered by domes of hard rock that can seal in gas when it is pumped in. Hundreds of billions of cubic feet of natural gas now are stored underground each summer to prepare for heavy use in severe winter weather.

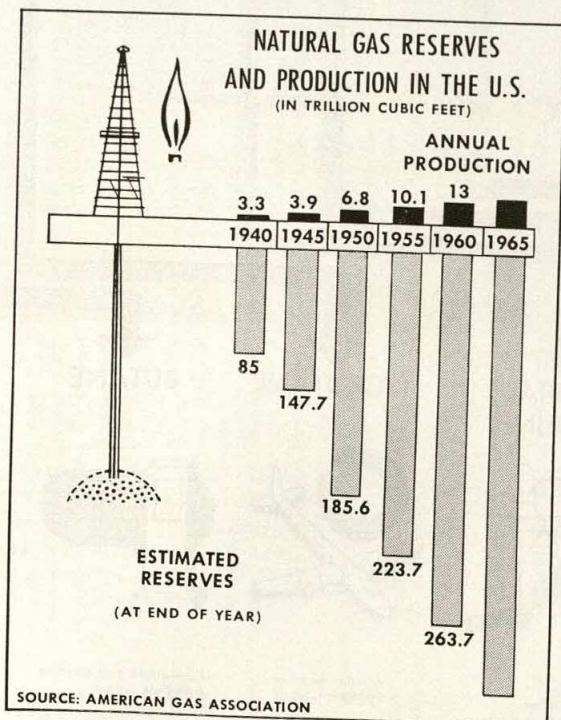
Composition of Natural Gas. Natural gas is made up mainly of chemical compounds of hydrogen and carbon. These compounds are called *hydrocarbons* (see HYDROCARBON). The principal hydrocarbons found in natural gas are *methane* and *ethane*, although there are often significant amounts of other members of the hydrocarbon family. Some of the heavier hydrocarbons such as *propane* and *butane* are commonly found in natural gas, as well as such chemical impurities as nitrogen, carbon dioxide, hydrogen sulfide, and sometimes helium.

Kinds of Natural Gas. Natural gas is classified according to its chemical formation, and according to the chemical impurities it contains.

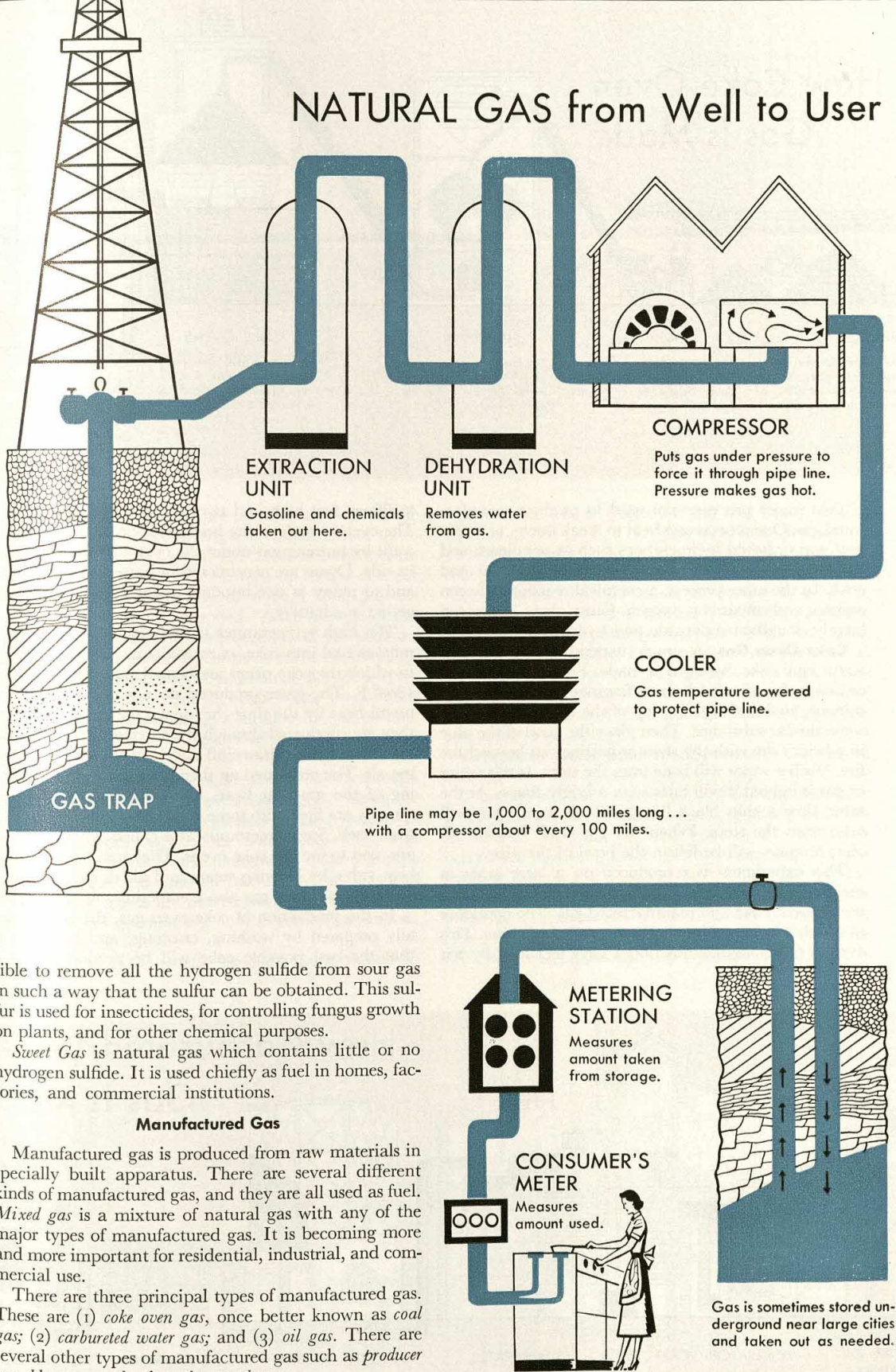
Wet Gas is natural gas which contains the heavier hydrocarbons such as propane, butane, *pentane*, *hexane*, and *heptane*. The heavy hydrocarbons can be condensed and extracted as liquids. These liquids form the basis of the natural gasoline industry, and provide important raw materials for the chemical industry. They also furnish an important portion of the supply of *liquefied petroleum gas*, or bottled gas fuel.

Dry Gas is natural gas from which the hydrocarbons heavier than methane and ethane have been removed. It is used as fuel by millions of customers.

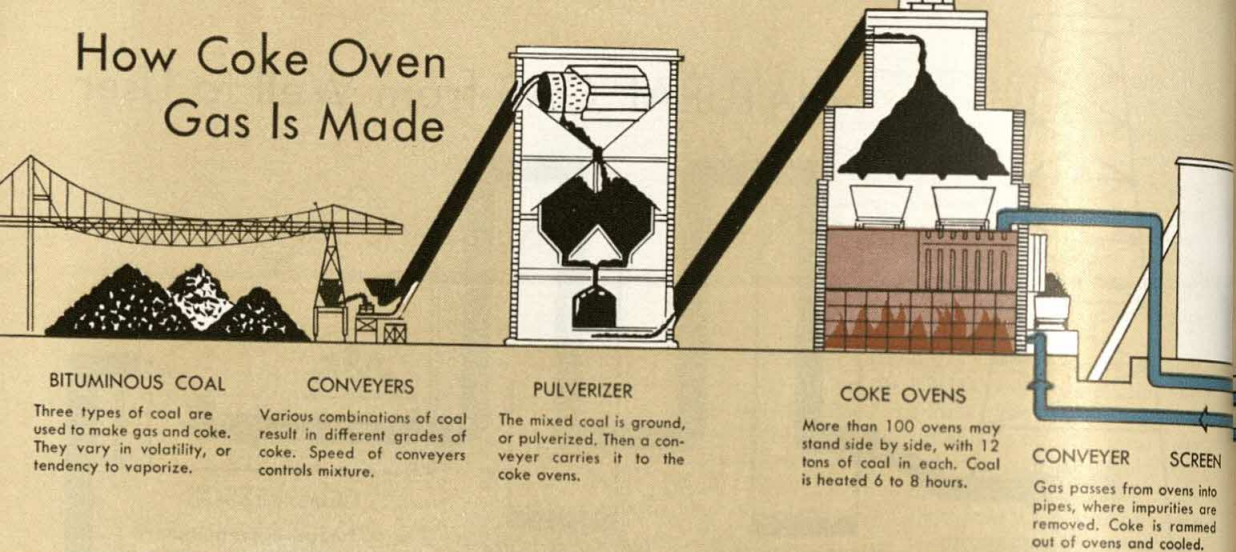
Sour Gas contains varying amounts of hydrogen sulfide. Raw sour gas is not often sold in its original chemical state for residential and industrial uses. Considerable quantities of sour gas are used to produce carbon black, which is a necessary ingredient in all rubber products, in black printing inks, and in many other products (see CARBON BLACK). Through modern techniques it is pos-



NATURAL GAS from Well to User



How Coke Oven Gas Is Made



Two major processes are used to produce manufactured gas. One process uses heat to break down, or *decompose*, gas or liquid hydrocarbons such as petroleum and natural gas, or solid carbon materials like coal and coke. In the other process, a chemical reaction between carbon and steam or oxygen forms gases composed largely of carbon monoxide and hydrogen.

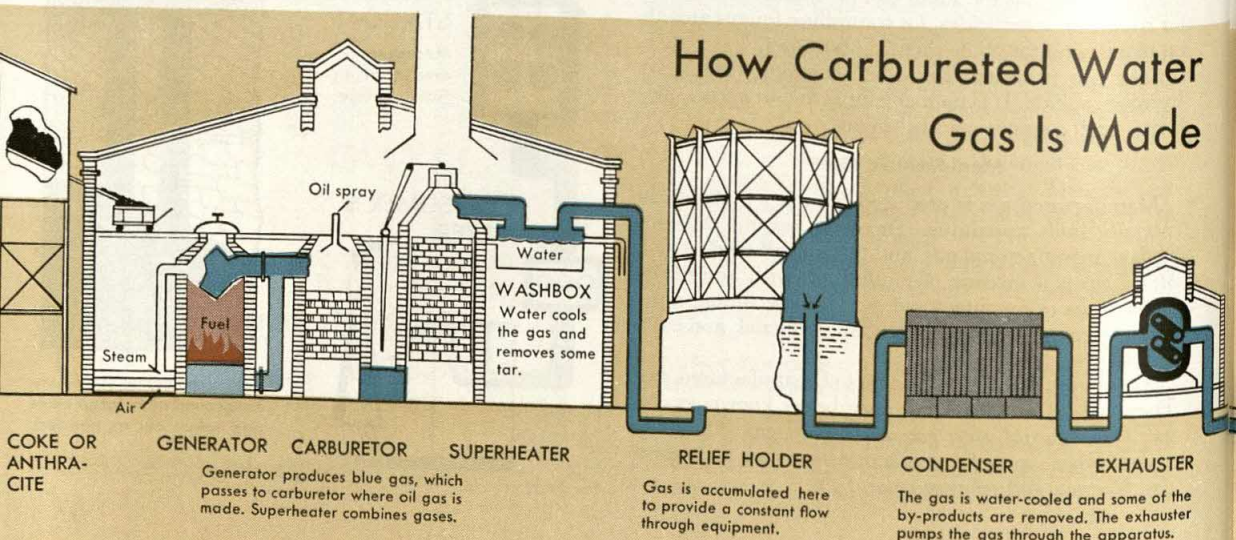
Coke Oven Gas. A simple experiment will demonstrate how coke oven gas is made. Fill the bowl of an ordinary clay pipe with small fragments of soft, or bituminous, coal and seal the top of the bowl with clay or some similar substance. Then place the bowl of the pipe in a bright fire with the stem projecting out beyond the fire. Visible vapor will issue from the stem. If this vapor or gas is lighted it will burn with a bright flame. At the same time a thin black liquid, which is coal tar, will ooze from the stem. When the gas is all burned off, *char*, or coke, will be left in the bowl of the pipe.

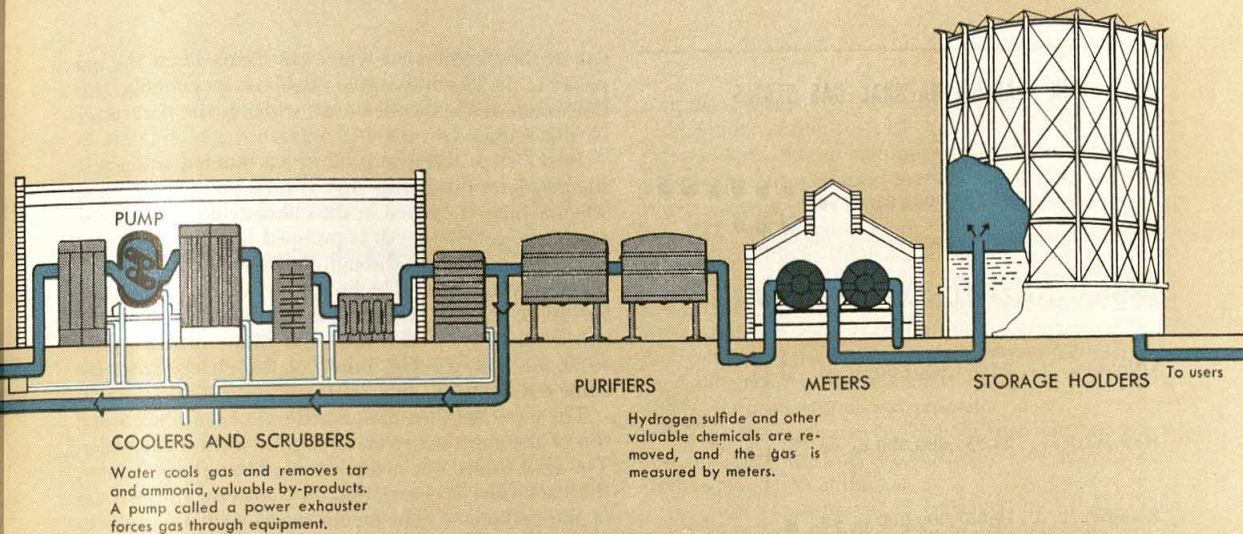
This experiment is reproduced on a large scale in making coke oven gas. Coal is heated to produce two useful fuels, coke and manufactured gas. The container in which it is heated is called a *by product coke oven*. This oven is a rectangular box about forty feet long by ten

to fifteen feet high and twelve to twenty inches wide. The oven is made of fire brick. It is heated through the walls by burning gas under the oven and in flues along its side. Ovens are constructed in batteries side by side, and as many as one hundred ovens may be joined together in a battery.

The high temperatures in the coke oven turn bituminous coal into coke, or *carbonize* it. The temperature to which the coke ovens are heated is generally around 1800° F. The gases produced do not give up all their useful heat by the time they leave the oven. Therefore they are conducted through flues to regenerators, where the excess heat is drawn off and used to preheat incoming air. The preheated air then is used to help the burning of the gas that heats the ovens. Coke ovens frequently are fired with some of the gas made by the coke oven itself. Sometimes apparatus called *producer gas sets* are used to fire the coke ovens. They make a gas of low heat value by blowing steam and air through a bed of burning coal. Blue gas also is sometimes used for firing.

In the production of coke oven gas, the coal is usually prepared by washing, crushing, and blending so that the best possible coke will be produced. About





twelve tons of coal usually are put into an oven at one time. This amount is converted to coke in about six to eight hours. The coke ovens are filled, or *charged*, with coal through openings in their tops by means of a car running on tracks over the oven tops. The amount charged is carefully controlled. After charging, the openings are closed and carbonization of the coal begins. During this period gas is given off in the ovens together with the by-products: ammonia, tar, sulfur compounds, naphthalene, and light oils. The by-products are removed to make the gas suitable for use as fuel. They are often sold and the cost of gas to the customer is thus reduced.

The gas and the by-products leave each oven through a large *off-take pipe* at the top. A *collecting pipe* along the whole battery of coke ovens gathers the gas by means of *bridge pipes* from each oven. Water containing ammonia and tar is circulated through the collecting pipe to cool the gas and take out the heavy tar. Gas and uncondensed vapors are moved through the system by pumps, or *power exhausters*, to the coolers, scrubbers, and purifiers.

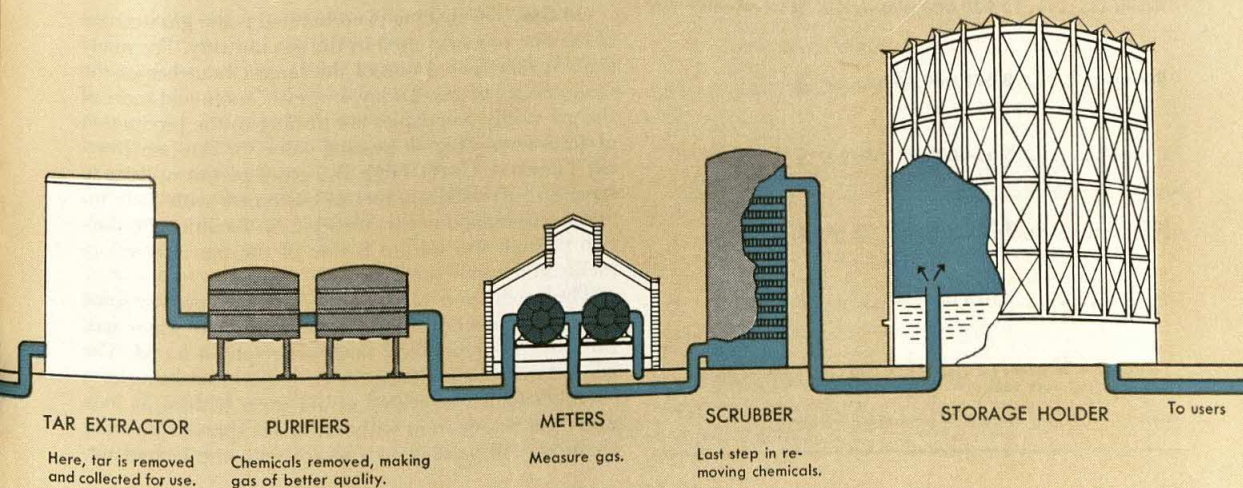
One ton of coal usually produces from 10,000 to

12,000 cubic feet of coke oven gas that has a heating value of 525 to 570 B. T. U. per cubic foot. (See **BRITISH THERMAL UNIT**.) Between 1,400 and 1,600 pounds of coke are produced along with the other by-products. After carbonization has taken place, the doors of the coke oven are removed by electric door-lifting machines. The red-hot coke is pushed out of the oven by a mechanical ram and is loaded into a waiting railroad car. It is sprayed with water to cool it and then dumped on to a storage pile to be used or sold.

The gas fuel is carried off through pipes to large storage tanks, or *gas holders*.

Carbureted Water Gas is made from coke, air, steam, and oil.

A carbureted water gas set consists of four units. First is the generator, a cylindrical steel vessel lined with firebrick. The generator contains coke or coal which is heated red hot to provide the heat necessary for gas making. Second is the carburetor to which the blue gas passes from the generator. The carburetor has channels made by a checkerwork of firebricks which first absorb heat from the generator, then give it off at the proper time to heat the gases and vapor passing through. Oil is



SIX LEADING NATURAL GAS STATES

Texas.....	185,787,000,000 cu. yd.	     
Louisiana.....	74,971,000,000 cu. yd.	   
Oklahoma.....	25,091,000,000 cu. yd.	 
New Mexico...	24,551,000,000 cu. yd.	 
Kansas.....	19,867,000,000 cu. yd.	
California.....	18,524,000,000 cu. yd.	

Each symbol  stands for 20,000,000,000 cubic yards of natural gas produced each year.

Based on a 4-year average of government statistics.

sprayed in at the top of the unit at the proper time and the process of *gasifying* the oil, or turning it into gas, is begun. The third unit is the *superheater* which is like the carburetor except that it is taller and contains more checkerwork. The superheater completes the gasification of the oil and fixes the combined blue gas and oil

SIX LEADING NATURAL GAS COUNTRIES

United States...	338,985,000,000 cu. yd.	           
Russia.....	12,900,000,000 cu. yd.	
Romania.....	8,648,000,000 cu. yd.	
Canada.....	5,054,000,000 cu. yd.	
Italy.....	4,362,000,000 cu. yd.	
Mexico.....	4,018,000,000 cu. yd.	

Each symbol  stands for 20,000,000,000 cubic yards of natural gas produced each year.

Based on a 4-year average of government statistics.

gas in their carbureted water gas form. Then the gas passes to the fourth unit, the washbox, for cooling. This unit condenses and collects tar, which is the part of the oil that cannot be turned into gas.

In the steps taken to produce carbureted water gas, the generator filled with coke is fired and gets red hot. Then a valve is opened in the chimneylike stack at the top of the generator. Air is pumped into the bottom of the generator and up through the coke. The fuel bed is raised to white heat. The hot gases that result pass into the spaces of the checkerwork of the carburetor and superheater. They raise the temperature of these units to about 1500° F. The bricks of the checkerwork become red hot.

The gases are then discharged out of the stack at the top of the superheater or through a waste heat boiler. The air is turned off, steam is turned into the generator, the stack valve is closed, and oil is injected into the top of the carburetor. The steam reacts with the coke to form carbon monoxide and hydrogen. These two gases pass into the carburetor where oil is being injected.

The mixture of carbon monoxide and hydrogen, or blue gas, and oil vapor passes down through the carburetor and up through the superheater. As the oil passes through the hot checkerwork in the carburetor and superheater, it is broken down into gases of high heating value. At this point the stack valve is closed and the carbureted water gas is forced out through a water seal of the washbox into the collecting mains.

Next the oil supply is shut off and the steam also is shut off. The stack valve is opened and air is again pumped into the generator to reheat the fuel bed and checkerwork. This replaces the heat which was removed in making the blue gas and the oil gas. This process of alternate blowing and gas making is repeated again and again, stopping only to add more fuel or to remove ashes. For this reason a carbureted water gas set is said to work in cycles. It first makes heat by burning coke or coal, and then uses that heat to gasify coke or coal and oil.

From the washbox, the gas passes to a relief holder. This is a small gas container used to equalize the flow of gas from the manufacturing unit through the purifying equipment. From the relief holder, an exhaustor draws the gas through the cooling and scrubbing apparatus which removes most of the tar and water vapors. Then it forces the gas through the remaining equipment into the storage holder.

Oil Gas. The making of carbureted water gas was one of the first processes used in the gas industry. For many years it represented one of the largest branches of the manufacture of gas. Today, however, more and more of the gas utility companies are turning to the production of gases with a higher heating value, or Btu (see BRITISH THERMAL UNIT). High Btu gases permit utilities to serve an increased number of customers with little increase in production and distribution facilities. Production of high Btu oil gas is one of the newer developments in manufactured gas.

The production of straight oil gas follows to some extent the process outlined for carbureted water gas. But, instead of fuel bins, tanks are required for oil. The generator house contains an *oil gas set* consisting of a chamber which is heated either from within, as in a water gas set, or from without. Oil is sprayed into this chamber and gasified by contact with the heated sur-

faces. This oil-gas process produces a gas with a heating value of about 500 Btu per cubic foot.

Several types of processes are used in making oil gases of high heating value. Such oil gas ranges from 900 to 1,200 Btu per cubic foot. The making of high Btu oil gas calls for the use of both light gas oils containing little or no free carbon, and heavy oils containing from 3 to 12 per cent of a certain type of carbon.

One method of making high Btu oil gas is called the *solid fuel process*. This process is much like the making of carbureted water gas. The carburetor and superheater are heated from a bed of solid fuel. Solid-fuel generator oil-gas sets are used generally as stand-by equipment. They are put into operation only on *peak load days*, when additional gas is needed for short periods.

Another process for making oil gas uses a *refractory screen* made of small blocks which can resist high temperatures. This screen replaces the fuel grate in the generator. The carbon set free by the process collects on the screen and is burned. Oil burners heat both the generators and the carburetors.

Water gas sets can be converted to the making of oil gas with high Btu by the twin generator and single generator methods. The generator and carburetor both serve as generators, and are sealed off at the bottom and connect at the top.

Oil-gas sets are generally considered more economical than other gas-making equipment. But the use of low-cost, heavy oils creates carbon deposits on the checkerwork. The plant has to be shut down frequently to remove the carbon. However, Edwin L. Hall of the American Gas Association has been granted patents on a high Btu oil-gas process that burns the deposited carbon and uses the heat thus generated in the oil-making process.

Liquefied Petroleum Gas

Liquefied petroleum gas is also known as LP gas, bottled gas, and tank gas. It is a fuel made up principally of butane or propane, or a mixture of the two. LP gas is produced chiefly in plants which process natural gas. Additional supplies come from oil refineries which process petroleum.

The principal use of LP gas is as fuel in farm, small-town, and suburban homes. LP gas is very important to the farmer. Poultry farmers use it to heat brooders and incubators. Dairy farmers use it to heat sterilizers for milking equipment and also for pasteurization of milk. Farmers and gardeners use LP gas in internal-combustion engines which operate irrigation pumps, lighting plants, corn-grinding equipment, and other machinery. Farmers and ranchers use this fuel in tractors and trucks and for flame weeding and cultivation.

Commercial and institutional users of LP gas include restaurants, hotels, motels, schools, and summer camps. Thousands of trucks, taxicabs, and buses burn LP gas.

This type of gas also has a wide variety of industrial uses, and new ones are fast being developed. The chemical industry uses vast amounts of butane and propane.

After processing, LP gas is a gas, but under moderate pressure it turns to a liquid. In this liquid state it is easily and economically transported and stored in pressure containers with special fittings. At normal atmospheric pressure and temperature the gas returns automatically to the gaseous state. The pressures within the

container increase as the temperature rises.

The heat content of LP gas is about three times greater than that of natural gas and about six times greater than that of most manufactured gas. At atmospheric pressure, pure butane *vaporizes*, or returns to gas, at 32°F. Pure propane returns to gas at -44°F. Under normal conditions, these are the lowest temperatures at which the liquid turns to gas. For this reason, propane is especially popular in cold climates and butane is used most widely in mild climates.

A mixture of the two gases may be used. The mixture may be adapted to any climate or season by varying the portions of butane and propane.

LP gas is nonpoisonous, heavier than air, and colorless. The suppliers add ingredients to give odor for ease in detecting leaks of the gas.

No place is too remote to be served by LP gas. This convenient fuel brings gas to small towns and rural areas throughout the United States.

H. CARL WOLF, WILLIAM B. HARPER, and ROBERT E. BORDEN

Related Articles in WORLD BOOK include:

Appliances	Gas Meter
Butane and Propane	Gas Oil
Carbon Black	Gasoline
Coal (Products from Coal)	Hydrocarbon
Coke	Methane
Conservation	Petroleum
Ethane	Pipeline
Federal Power Commission	Producer Gas
Fuel	Refrigeration

Outline

I. How Man Learned to Use Gas

- Early Uses
- Discovery of Manufactured Gas
- Early Developments in the United States
- Improvement of Gas Flame for Lighting
- The Early Gas Stove
- Growth of the Modern Gas Industry

II. Natural Gas

- How Natural Gas Was Formed
- Products of Natural Gas
- Where Natural Gas Is Found
- Natural Gas Reserves
- Exploration and Drilling
- From Well to User
- Underground Storage
- Composition of Natural Gas
- Kinds of Natural Gas

III. Manufactured Gas

- Coke Oven Gas
- Carbureted Water Gas
- Oil Gas

IV. Liquefied Petroleum Gas

Questions

- How was natural gas formed?
 Name five chemical products of natural gas.
 How much fuel energy in the United States is supplied by natural gas?
 What are the two leading gas-producing states? How much gas do they produce?
 How many miles of natural-gas line are now used?
 What is mixed gas? LP gas?

GAS, POISON. See POISON GAS.

GAS, TEAR. See TEAR GAS.

GAS BLACK. See CARBON BLACK.

GAS CHAMBER. See LETHAL CHAMBER.

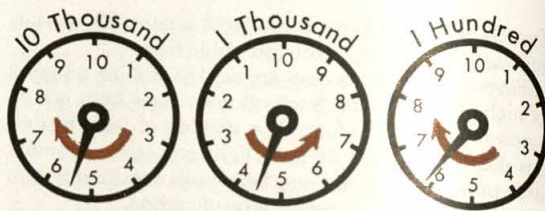
GAS ENGINE. See GASOLINE ENGINE.

GAS MASK

GAS MASK protects the wearer from breathing harmful gases into the lungs. The face of the mask is made of materials which have been chemically treated to keep out gases. The mask fits tightly to the face and fastens on with straps. Air that a person inhales passes first through an air-purifying canister. This filters out the harmful gases by chemical means. The carrier for the gas mask used by United States armed forces is watertight and serves to some extent as a life preserver for assault troops going ashore. In World War I, troops used gas masks widely. Soldiers and civilians in World War II found them unnecessary, because no country used poison gas. Mine rescue workers, many workers in chemical industries, and firemen who must enter smoke-filled buildings use gas masks. See also **POISON GAS**.

The **Lightweight Gas Mask** developed by the United States Army is more efficient and easier to wear than the masks used during World War II. The air-purifying canister is attached to the cheek. This feature eliminates the need for a breathing hose.

U.S. Army



Reading a Gas Meter is almost as easy as reading time on a clock. The meter may have three or four main dials. Begin with the first, or left-hand, meter dial and read the figure at which the hand points on each dial. If the hand rests between two figures, use the highest figure the hand has passed. The meter dials shown here read 5, 4, and 6. You add two ciphers and get 54,600. From this, subtract the meter reading shown on the last gas bill. The result will be the cubic feet of gas used since the last reading.

GAS METER is a device for measuring in cubic feet the volume of gas used. It usually is a tight metal box divided through the center into two separate chambers, or *bellows*. Each of these chambers has a movable partition which divides it into two parts, making four separate chambers in all.

The gas is measured by first filling and then emptying each of these four chambers, and automatically registering the number of times each is filled and emptied. The volume of each chamber is fixed and tested under state supervision. While one chamber is being filled another is being emptied, so that the consumer receives an even flow of gas at all times.

The upper part of the meter contains the mechanism for registering the movement of the various chambers in cubic feet and showing the volume on a set of dials. Gas meters register volumes of gas accurately. State authorities permit their legal use as measuring devices for periods as long as 21 years before requiring rechecking of the meter.

J. STANFORD SETCHELL

GAS OIL is one of the parts, or *fractions*, into which petroleum is divided by distillation. Gas oil comes from about the "middle" of the still. It is heavier than gasoline, kerosene, light fuel, and diesel oils, and lighter than the *lube distillate* from which lubricating oils and waxes are made. The name *gas oil* comes from the use of this oil in the manufacture of gas fuel. Industry now uses it chiefly to produce gasoline, kerosene, and chemicals. See also **GAS (Oil Gas)**; **PETROLEUM (Refining Petroleum)**.

GAS POISONING. See **POISON GAS**; **FIRST AID (Antidotes)**.

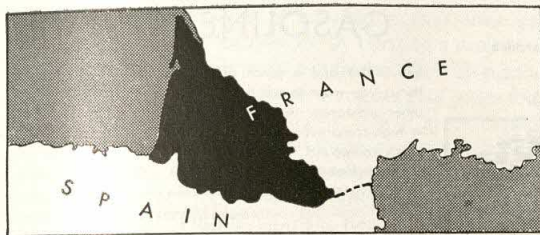
GAS STATION. See **PETROLEUM (Service Stations)**.

GAS SYNTHESIS. See **COAL (Gas Synthesis)**.

GAS TURBINE LOCOMOTIVE. See **LOCOMOTIVE**.

Gascony, *GAS koh nih*, an old French province, lies between the Pyrenees Mountains and the Garonne River in southwest France. It took its name from the *Vascons*, or *Basques*, who came from Spain in the 500's. The people grow corn, wheat, and fruits, and raise geese and turkeys. Cities include the resort of Biarritz, the pilgrimage city of Lourdes, and Auch, formerly the capital.

The Franks conquered Gascony and organized it as a duchy under the late Carolingians. It became an important feudal state of southern France. In the 1000's, it became part of the duchy of Aquitaine, which Henry II of England acquired in the 1100's. Gascony was the



Location of the Former French Province of Gascony

scene of constant fighting between French and English forces until the end of the Hundred Years' War. The French finally won the region then. According to tradition, the Gascons are brave and gallant, but somewhat given to boasting. The English word *gasconade* means bragging or blustering talk. D'Artagnan, hero of *The Three Musketeers* by Dumas, is a fine example of the Gascon soldier in literature.

ROBERT E. DICKINSON

GASIFICATION. See COAL (Gasification).

GASKELL, ELIZABETH CLEGHORN (1810-1865), a British author, is remembered chiefly for two books, *Cranford* (1853) and *The Life of Charlotte Brontë* (1857). *Cranford* portrays, with delicate humor, life in the village where she spent her childhood. Born in London, she lived in Manchester and wrote about the troubles of poor city workers in the novels *Mary Barton* (1848) and *North and South* (1855).

LIONEL STEVENSON

GASOLINE is the fuel which provides power for much of the swift transportation of today. It is obtained from petroleum or from natural gas, and can also be made from coal. Its quick- and hot-burning qualities make gasoline an ideal fuel for internal-combustion engines such as those used in automobiles, airplanes, and motorboats. Gasoline also is used as a cleanser, as a solvent, and in many other ways. In Great Britain and certain other countries, gasoline is called *petrol*.

Kinds of Gasoline. When you stop for gasoline at a filling station, the attendant usually asks, "Special or regular?" He fills the tank with the gasoline you choose.

The chief difference between regular and special, or premium, gasolines is the content of antiknock compound, which affects *octane number*. Octane number is simply a rating of the gasoline's freedom from "knock," or "ping," when it is burned in an engine. This noise results from uncontrolled burning of the gasoline in the engine's cylinders. A knock or ping commonly means that the gasoline is not exactly suited to the engine. High-compression engines require high-octane fuel for knock-free operation. See GASOLINE ENGINE; OCTANE NUMBER.

Octane rating is based on the chemical make-up of gasoline. Gasoline is made up of hydrogen and carbon atoms combined into various kinds of molecules called *hydrocarbons*. The liquid hydrocarbons commonly used to produce gasoline have from four to 12 carbon atoms in each molecule, and *vaporize*, or boil, at temperatures from about 100°F. to about 400°F. The quality of the gasoline is affected by the proportions of hydrogen and carbon atoms in each hydrocarbon molecule, and also by the way the atoms join together to form molecules. One of these hydrocarbons is called *normal heptane* (chemical formula, C_7H_{16}). It has seven carbon atoms arranged in a straight chain, and 16 hydrogen atoms

in each of its molecules. Another hydrocarbon is *iso-octane* (chemical formula, C_8H_{18}), which has eight carbon atoms arranged in a branched chain, and 18 hydrogen atoms. Normal heptane has so much tendency to knock in an engine that it has been given an octane rating of zero. A fuel made entirely of iso-octane has so little tendency to knock that it is given a rating of 100 octanes. The most generally accepted method of testing octane numbers gives what is called the *research-octane number*. By this method, regular gasolines are found to average about 82½ octanes, and premium gasolines about 90 octanes. The octane level of automobile gasolines varies greatly in different parts of the United States. Most piston-type aircraft engines require gasolines far beyond 100 octanes.

Tetraethyllead is added to both regular and premium automobile gasolines, and to aviation gasoline, to increase their octane ratings. But so-called "white," or *unleaded*, gasoline does not contain this compound. White gasoline is produced as fuel for lanterns and camp stoves, compounds for blending into dry-cleaning fluids, and other special purposes.

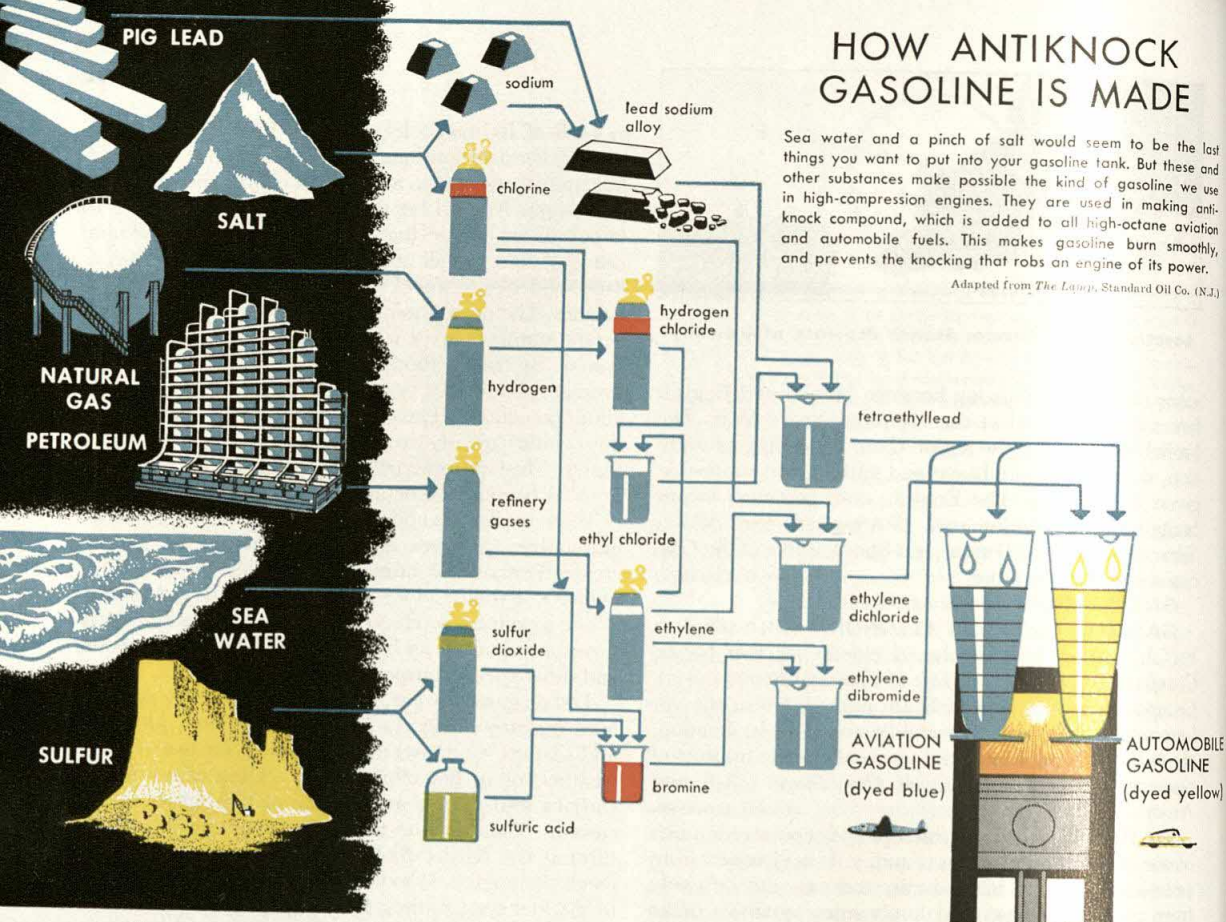
Today, gasolines are "tailor-made" to make automobiles operate efficiently in various climates, altitudes, and seasons. Chemists design gasoline for use in warm weather, or in hot climates, by adding heavy hydrocarbons and taking away some of the lighter hydrocarbons. This is done to keep the summer heat from turning the lighter molecules into vapor before they reach the engine. If too many light molecules vaporize in the fuel system, they prevent the flow of gasoline to the engine. This condition, called *vapor lock*, stalls the engine. The increased evaporation of these light molecules also causes loss of gasoline from the fuel tank. See VAPOR LOCK.

Gasoline for use in winter and in cold climates is made to contain more of the lighter hydrocarbons such as butane, and fewer of the heavier ones. The lighter hydrocarbons vaporize easily and thus make it easier to start a cold engine.

Gasolines made for use in mountain regions have some of their lighter hydrocarbons removed and heavier ones added. This is done because the lower atmospheric pressures at high altitudes reduce the boiling, or *vaporization*, point of gasoline. A gasoline containing too many light hydrocarbons would cause vapor lock and loss through evaporation. Some refineries produce twenty or more different blends of gasoline to meet special conditions of heat, cold, and atmospheric pressure.

How Gasoline Is Produced. *Natural gasoline* is obtained from natural gas. The natural gas flows from the well and is collected in an absorption plant. Then it is compressed and chilled. This causes the gasoline to become liquid. As much as a gallon of gasoline may be drawn off from a thousand cubic feet of gas. Natural gasoline is blended with other gasolines. It also is called *casinghead gasoline*. See GAS (fuel).

Straight-run gasoline is a low-octane fuel which is produced by heating petroleum in the fractionator, or bubble tower, of the refinery until the gasoline part of it vaporizes. The vapor then is drawn off and cooled into liquid. Higher-octane gasolines are produced by various refining processes (see PETROLEUM [Refining Petroleum]).



The gasolines are blended together and treated chemically to make various grades of fuel.

Additives. In addition to tetraethyllead and other antiknock compounds, gasoline manufacturers put other additives in gasoline for various purposes. *Antioxidant inhibitors* prevent gasoline hydrocarbons from absorbing oxygen or from combining with each other to form heavy resinous compounds that affect the quality of gasoline. *Metal deactivators* protect gasoline from the effect of picking up metals during the refining process or in the fuel systems of vehicles. Copper and other metals may cause the formation of gum in gasoline or may harm the antiknock compound.

Other compounds are added to gasoline to prevent or reduce surface ignition. In surface ignition, combustion-chamber deposits become hot, and cause a portion of the gasoline to ignite before it should normally. This is also called *preignition*. It is usually controlled by means of various phosphorus compounds. These compounds also reduce or prevent sparkplug misfiring, which is usually caused by metallic deposits on the plugs.

History. In the early days of the oil industry, gasoline was a nuisance to refiners (see PETROLEUM [Oil and the Automobile]). In refining, more gasoline was produced than could be used. A small amount was burned in a type of cookstove built especially for the purpose. It was not even called gasoline then, but was known as *stove naphtha*. A little gasoline was used for lighting city streets. Some also was burned in a few crude stationary gasoline engines. These were the ancestors of the more

complicated engines used in automobiles today.

Within a few years, the automobile changed the entire situation in the oil industry. Refiners no longer tried to dispose of a troublesome and apparently almost useless liquid, but strained every effort to produce enough of it to supply the demands of the motoring public. Introduction of the Burton *cracking* processes in 1913 produced more gasoline from the same amount of petroleum. This process also unexpectedly improved the octane rating of gasoline.

Engineers sought even higher octane ratings. Low-octane fuels made engines knock, and the knocking increased almost unbearably every time engineers tried to increase the power of engines through higher compression. In 1916, Charles F. Kettering and Thomas Midgley began research to develop an antiknock fuel. They put a quartz window in the side of an engine cylinder and watched the gasoline explode, to find out what caused knock. Some engineers had thought knock was caused by battery ignition. But Kettering and Midgley found the fuel was responsible. They developed a tetraethyllead compound which made the knock disappear (see TETRAETHYLLEAD). Tetraethyllead, or *ethyl*, gasoline first went on sale in February, 1923, at a filling station in Dayton, Ohio. After that, many other improvements in gasoline were made. In 1955, a new refining process called *Rexforming* was announced by the petroleum industry. It is an economical method of producing automobile gasoline with an octane rating of more than 100.

WILLIAM B. HARPER

GASOLINE ENGINE is an engine that uses gasoline as a fuel. It performs work by burning a mixture of gasoline vapor and air *inside* a cylinder. For this reason, it is called an *internal-combustion* engine. Hot gases form when the fuel-air mixture burns. These gases expand rapidly, driving a piston that turns a crankshaft. The crankshaft can be used to turn wheels and propellers, or to operate pumps, saws, and other machines. In this way, a gasoline engine changes heat energy into mechanical energy. The rate at which a gasoline engine produces work is usually measured in horsepower (see HORSEPOWER).

Gasoline engines are compact and light in weight for the power they produce. This makes them one of the most important types of engines for vehicles. Nearly all automobiles, motorcycles, and motor scooters have gasoline engines. So do many trucks, buses, airplanes, and small boats. These engines may also be used as portable power plants—for example, to supply the power to run pumps and other machinery on farms.

Kinds of Gasoline Engines

Gasoline engines are classified in a number of ways. These include (1) by the number of piston strokes per cycle, (2) by the type of compression, (3) by the way they are cooled, (4) by their valve arrangement, (5) by their cylinder arrangement, and (6) by the way they are supplied with air and fuel.

Cycle. All gasoline engines operate on either a two-stroke or a four-stroke cycle. *Cycle* means the steps that must be repeated for each combustion of the fuel-air mixture in the cylinders. *Stroke* means the up-and-down movements of the pistons. A *four-stroke* cycle engine has intake, compression, power, and exhaust strokes. A *two-stroke* cycle engine combines the exhaust and intake steps near the end of the power stroke. This process is inefficient, because some of the new fuel-air mixture is expelled with the exhaust and not all the exhaust is expelled. Although two-stroke cycle engines are inefficient, they are simpler and cheaper to build than four-stroke cycle engines. Therefore they are used where low cost is important, as for a power lawn mower. In small sizes, the two-stroke engine delivers more power for a given weight than the four-stroke engine.

High and Low Compression. When a gas expands and pushes against a piston, the more its volume increases, the greater the work performed. The ratio between the volume of the gas when it is compressed and when it is expanded is its *expansion ratio*. If the gas expands to twice its compressed volume, the ratio is 2 to 1; if three times, the ratio is 3 to 1. The expansion ratio also equals the *compression ratio*—the difference in volume before and after compression. To be efficient, an engine should have a big expansion ratio. This also means it must be a *high-compression* engine.

Early gasoline engines had ratios of 2 to 1 or 3 to 1 and burned low-octane gasoline (see OCTANE NUMBER). They were *low-compression* engines. Today's low-compression engines may have compression ratios of 6 or 8 to 1 and burn higher octane gasoline. A modern high-compression engine may have a compression ratio of 10 or 12 to 1, and needs still higher octane gasoline.

Cooling. The burning fuel-air mixture in a cylinder produces temperatures of about 1,500° to 4,500°F. Therefore, the metal parts of the engine must be cooled

or they would melt. Most automotive gasoline engines are *liquid cooled*. A liquid, usually water, is circulated around the cylinders to cool the metal. The heated liquid is then pumped through a radiator. A fan driven by the engine draws air through the radiator to cool the liquid.

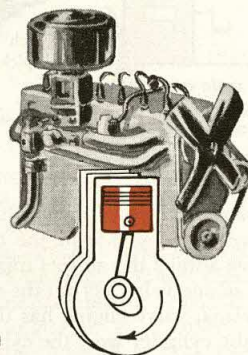
Most aircraft gasoline engines are *air cooled* to reduce weight. Air is not so effective a coolant as liquids, so the outside of the cylinders of aircraft engines have many metal fins. These fins conduct heat out of the cylinder and offer a large surface area for the air to sweep over.

Valve Arrangement. The two most common valve arrangements are (1) L-head and (2) I-head. An *L-head*,

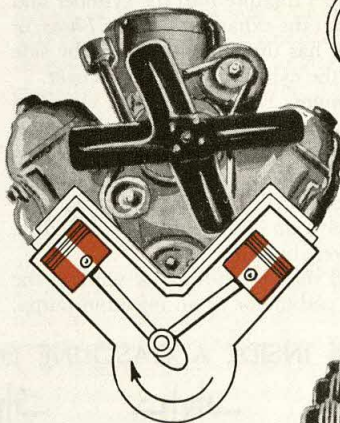
TYPES OF GASOLINE ENGINES

Engines are classified according to the arrangement of the cylinders. In-line and V-type are used in most automobiles. Horizontal-opposed and radial are used in most propeller-driven airplanes.

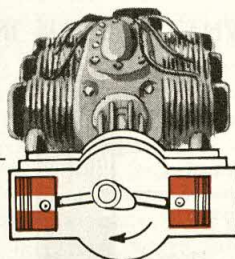
IN-LINE



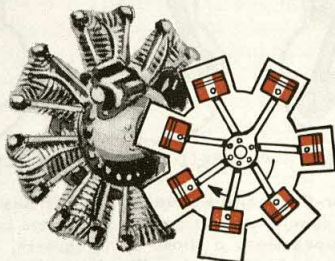
V-TYPE



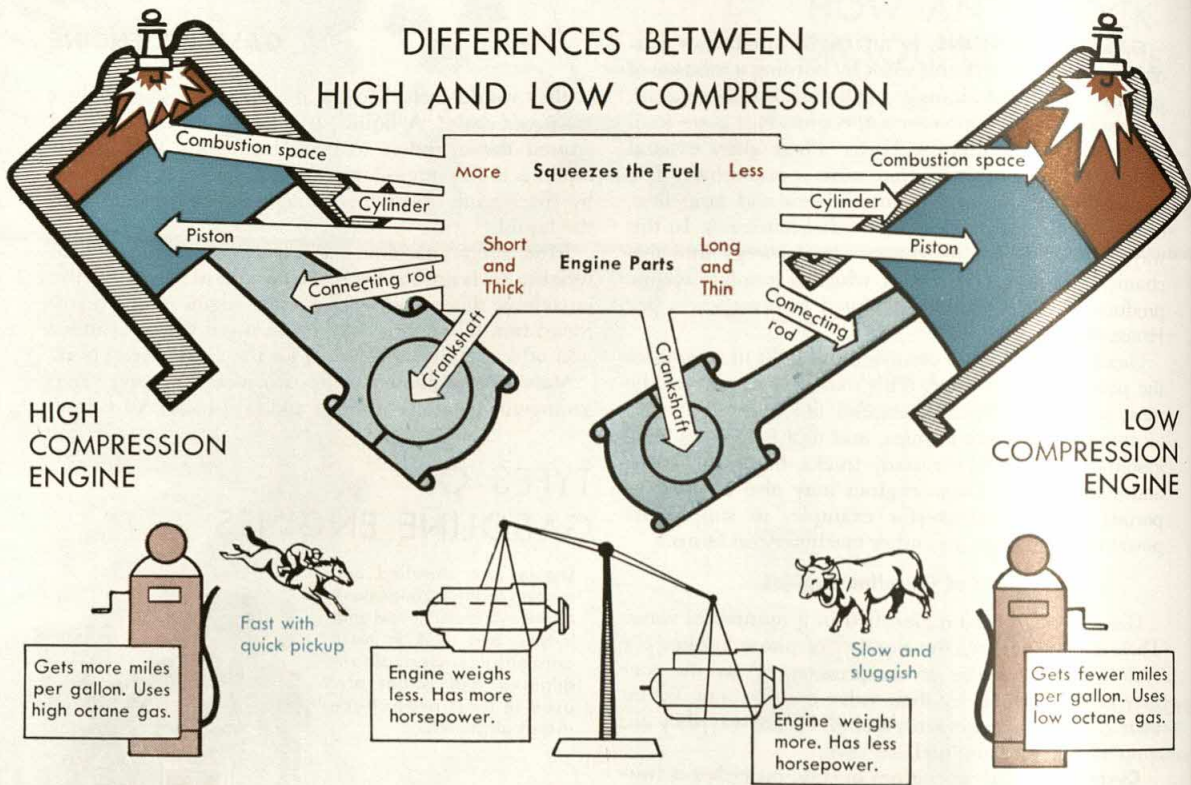
HORIZONTAL-OPPOSED



RADIAL



DIFFERENCES BETWEEN HIGH AND LOW COMPRESSION



or *underhead*, valve engine has the intake and exhaust valves side by side in the cylinder block. The *intake* valve admits the air-fuel mixture into the cylinder and the *exhaust* valve lets out the exhaust gases. An *I-head*, or *overhead*, valve engine has the two valves side by side in the cylinder *head*, the cylinder block's top cover.

Cylinder Arrangement. Engines are also classified by the number and arrangement of cylinders. The most common types include *in-line*, *V*, *radial*, and *horizontal opposed*. All gasoline engines, except the radial type, have an even number of cylinders—four, six, eight, or 12. Radial engines have an odd number of cylinders, such as three, five, seven, or nine.

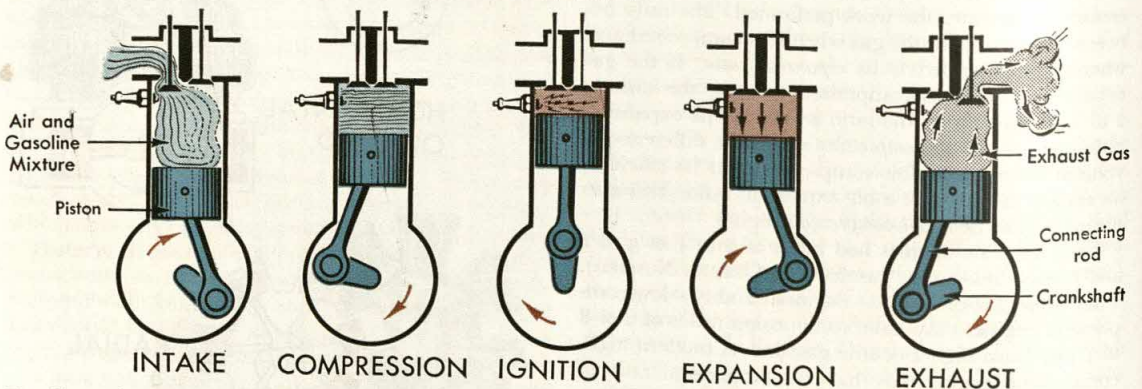
Air and Fuel. Fuel may be *metered*, or sent, to the cylinders by either a carburetor or an injection pump.

Therefore, gasoline engines are also classified as *carbureted* or as *fuel-injection* engines (see **CARBURETOR**; **FUEL INJECTION**). It is easy to force an excess amount of fuel into an engine, but not an excess of air. Because combustion depends upon both air and fuel, the power output of an engine is limited by the amount of air reaching the cylinders. To increase power, an engine may be *supercharged*. A *supercharger* is an air pump that forces extra air to the cylinders (see **SUPERCHARGER**). A gasoline engine uses about 15 pounds of air for each pound of gasoline.

Parts of a Gasoline Engine

Cylinder Block is a rigid frame that holds the cylinders in proper alignment. If the engine is liquid cooled, the

WHAT HAPPENS INSIDE A GASOLINE ENGINE

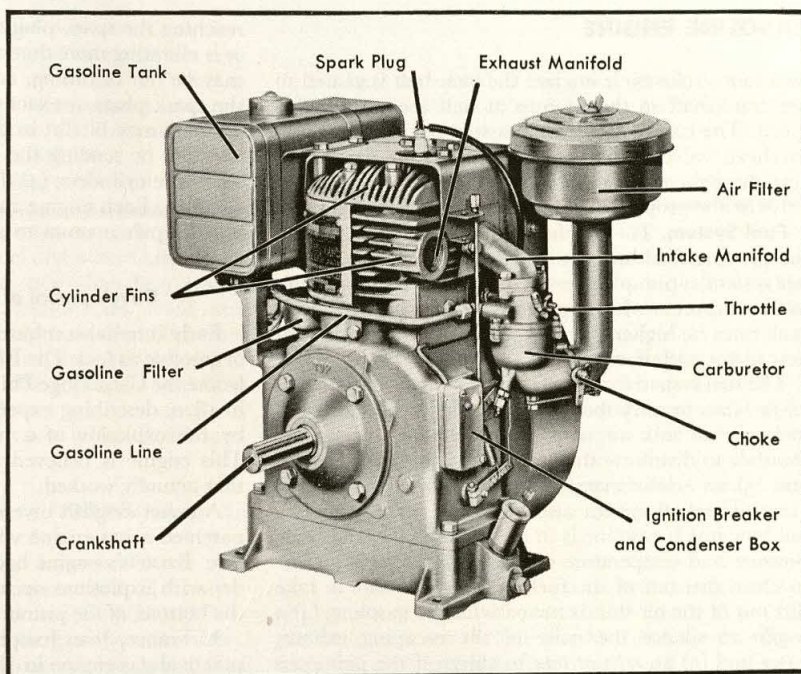


The Piston in a Four-Cycle Engine Makes Four Strokes.

(1) **Intake**, a stroke down to draw a gasoline-air mixture into the cylinder. (2) **Compression**, a stroke up to squeeze, or compress, the fuel mixture. **Ignition**, or setting fire to the fuel

with an electric spark, takes place at the top of the compression stroke. (3) **Expansion**, or **power**, a stroke down to deliver power from the burned and expanding gases to the crankshaft. (4) **Exhaust**, a stroke up to push out burned gases.

Small Gasoline Engine of kind used to turn pumps or other light machinery. This single-cylinder, four-cycle engine develops five horsepower. Air circulates around the cylinder fins to cool the engine. A hand crank or rope is used to start the engine. A small magneto makes electric current for ignition. An exhaust pipe must be fastened to the exhaust manifold to carry off poisonous exhaust gases from the engine.



Briggs & Stratton

block is *jacketed*, or has passages for the liquid around each cylinder. In automotive engines, the cylinder block and crankcase form a single unit. Cylinder blocks are usually made of cast iron, although aluminum is sometimes used.

Cylinders are like tubes or sleeves, and serve as a bearing for the pistons which move up and down inside of them. They have highly polished surfaces. This permits a close fit between the piston and the cylinder and prevents gases from leaking past the piston. A cylinder *sleeve* is sometimes made of specially hardened steel or cast iron. This sleeve is then pressed into the cylinder block. In radial engines, the cylinders are made as separate units, usually of forged steel.

Cylinder Head is a casting bolted to the top of the cylinder block. The cylinder head, together with the upper end of the cylinder and the top of the piston, form the *combustion chamber* where the fuel-air mixture burns. The cylinder head is also jacketed, like the block, for liquid-cooled engines. A copper or copper-asbestos *gasket* is placed between the block and the head to form a seal and prevent gases from escaping. In some engines, especially radial engines, each cylinder has a separate head. A cylinder head and block may also be made as a single unit.

Crankcase is a rigid frame that holds the crankshaft and the crankshaft bearings. In small engines, all or part of the crankcase may be a part of the cylinder block. An *oil pan* bolted to the bottom of the crankcase holds the oil that lubricates the engine.

Pistons and Connecting Rods. When the fuel-air mixture burns, the expanding gases exert a force on the *piston*. This force is then transmitted through a *connecting rod* to the crankshaft. The upper end of the connecting rod is attached to the piston by a *piston pin*. The lower end of the rod has a bearing and is clamped to the crankshaft. The piston has from three to six or more

rings to prevent the gases from escaping past the piston and to keep lubricating oil from getting into the combustion chamber. See **PISTON**.

Crankshaft changes the up-and-down, or *reciprocating*, motion of the pistons into a turning, or *rotary*, motion. The crankshaft has a number of cranks, or *throws*. These cranks are displaced at angles to each other. For example, a six-cylinder, in-line, four-stroke cycle engine delivers six power strokes in two revolutions of the crankshaft. The cranks are displaced at 120° angles from each other so that the power strokes are evenly spaced in the two revolutions.

Flywheel stores up energy during a piston's power stroke and releases energy during its other strokes. This helps to turn the crankshaft at a constant speed (see **FLYWHEEL**). In an automobile, the flywheel is at the rear end of the crankshaft. In a car with a manual transmission, the rear face of the flywheel is smooth and acts as a pressure surface connecting the clutch plate to the crankshaft (see **TRANSMISSION**). The rim of the flywheel has gear teeth that mesh with the gear of the starter motor that cranks, or starts, the engine (see **STARTER**). In aircraft, the propeller serves as a flywheel.

Valves. In a four-stroke cycle engine, each cylinder has an intake valve, to let the air-fuel mixture into the combustion chamber, and an exhaust valve, to let the burned gases escape. These are called *poppet valves*, because they pop up and down as they open and close. They are also called *mushroom valves*, because they are shaped like mushrooms. The opening in the cylinder block or head uncovered by the valve is called the *valve port*. The rim of the port is ground at an angle to form the *valve seat*. Like cylinders, valve seats may be made of specially hardened steel inserts.

Camshaft opens and closes the valves. It runs the length of the engine and has two cams at each cylinder—one for the intake valve and one for the exhaust valve.

GASOLINE ENGINE

In a four-stroke cycle engine, the camshaft is geared to the crankshaft so that it runs at half the crankshaft's speed. The camshaft may be located in the head of an overhead valve engine, or in the crankcase. Each cam acts through a *follower*, *tappet*, or *push rod* to open a valve at the proper point in the engine cycle. See CAM.

Fuel System. The two fuel systems in general use are the pressure feed and the gravity feed. In the *pressure-feed* system, a pump forces the fuel from the storage tank to the carburetor. In the *gravity-feed* system, the storage tank must be higher than the carburetor so the fuel will flow to the carburetor.

The fuel system includes (1) a *storage tank* for gasoline, (2) *fuel lines* to carry the gasoline to the carburetor, (3) a *carburetor* to mix air with the gasoline, (4) an *intake manifold* to distribute the fuel mixture to the cylinders, and (5) an *exhaust manifold* to carry away the burned gases. The fuel system also includes (1) *fuel gauges* to tell how much gasoline is in the storage tank and show pressure and temperature of the fuel, (2) a *gasoline filter* to clean dirt out of the fuel, (3) an *air cleaner* to take dirt out of the air that is mixed with the gasoline, (4) a *muffler* to silence the noise of the escaping exhaust gases and (5) an *exhaust pipe* to carry off the poisonous exhaust gases (see CARBON MONOXIDE). A *governor* may be included in the system to limit the speed of the engine. See CARBURETOR; GOVERNOR.

The Ignition System is the electrical circuit necessary to set fire to, or *ignite*, the fuel mixture in the different cylinders at different times. In an automobile a *storage battery* provides electric current, which is increased in voltage by an *induction coil*. The high-voltage current is carried through a *distributor*, which delivers the electricity to each cylinder at about the moment the piston reaches the top of the compression stroke. There the electric current jumps a gap between two terminals and sets fire to the gasoline-air mixture. The terminals are encased in insulating material and called a *spark plug*. In an airplane engine, the high-voltage electric current is generated by a *magneto* and carried to the spark plugs. See BATTERY; IGNITION; MAGNETO.

Lubrication System provides oil as a film between the moving parts of the engine to prevent wear from friction and to keep the engine cool. The two common types of engine lubrication systems are the *wet sump* and the *dry sump*. In the wet-sump engine, the oil supply is contained within the engine, in the bottom of the crankcase. In the dry-sump engine the oil supply is contained in a separate oil tank and pumped to the moving parts.

Wet-sump systems may be of two types—splash or full-pressure. In *splash lubrication*, dippers on the ends of the connecting rods create a spray of oil which lubricates the cylinder walls, the crankshaft, and all other moving parts. In *full-pressure lubrication*, oil is pumped through passages in the crankshaft and the connecting rods to the pistons.

Common Troubles with Gasoline Engines

There are so many parts to a gasoline engine that many more things can go wrong than can be discussed in the short space of this article. If the engine will not run, the important things to check are whether the engine is getting gasoline and whether electricity is

reaching the spark plugs. If the engine runs unevenly, or is vibrating more than normal: (1) the ignition system may be out of timing, or not be sending electricity to the spark plugs at exactly the right moment for firing; (2) there may be dirt in the fuel line; (3) the carburetor may not be sending the right mixture of gasoline and air to the cylinders; (4) the valves and valve seats may be worn. Each engine manufacturer can furnish a detailed repair manual to go with any particular engine he makes.

Development of the Gasoline Engine

Early internal-combustion engines used gases instead of gasoline as fuel. The Reverend W. Cecil read a paper before the Cambridge Philosophical Society in England, in 1820, describing experiments with an engine driven by the explosion of a mixture of hydrogen and air. This engine is believed to be the earliest gas engine that actually worked.

Another English inventor, William Barnett, in 1838 patented a gas engine which compressed the fuel mixture. Barnett's engine had a single up-and-down cylinder with explosions occurring first at the top, then at the bottom, of the piston.

In France, Jean Joseph Étienne Lenoir built the first practical gas engine in 1860. It used street-lighting gas for fuel. This single-cylinder engine had a storage-battery ignition system. By 1865, four hundred of these engines were in use in Paris for such jobs as powering printing presses, lathes, and water pumps. Lenoir installed one of his gas engines in a crude motor vehicle.

In 1862 another Frenchman, Beau de Rochas, worked out on paper the idea of the four-cycle engine. But he did not build one. Four years later Nikolaus August Otto and Eugen Langen of Germany built a successful four-cycle gas engine. In 1876, Otto and Langen obtained patents in the United States on both two-cycle and four-cycle gas engines.

In Austria, in 1864, Siegfried Marcus built a Lenoir-type engine which used gasoline as a fuel. He used it to power a crude automobile. An American engineer, George B. Brayton, built an engine which used gasoline as a fuel, and exhibited it in Philadelphia in 1876.

The first successful four-cycle engine to burn gasoline was designed in 1885 by Gottlieb Daimler, an associate of Otto and Langen. In the same year, Karl Benz, another German, also developed a successful gasoline engine. These engines were basically the same as gasoline engines built today. For later development of the gasoline engine, see AUTOMOBILE.

EDWARD F. OBERT

Related Articles in WORLD BOOK include:

PARTS OF A GASOLINE ENGINE

Battery	Fuel Injection	Magneto
Cam	Governor	Piston
Carburetor	Ignition	Starter
Cylinder	Induction Coil	Supercharger
Flywheel		

UNCLASSIFIED

Airplane (Engines)	Daimler, Gottlieb	Lenoir, Jean
Antifreeze	Diesel Engine	Joseph Étienne
Army (Mechanized Armies)	Engine Analyzer	Transmission
Automobile	Free-Piston Engine	Turbine (Gas Turbines)
Benz, Karl	Gasoline Horsepower	Vapor Lock

GASOLINE TAX is a tax on the purchase of gasoline. The United States government and all the states levy motor fuel taxes. Governments use motor fuel taxes to build and improve roads. Off-the-highway users of motor fuel such as airplanes, boats, and farm machinery pay the tax, but get a partial refund later.

In the late 1950's, the federal government collected about \$1,637,000,000 a year from its excise tax on gasoline. It levied a tax of three cents on each gallon of gasoline. It also taxed diesel fuel and other fuels. At the same time, the states collected more than \$2,914,000,000 a year from their motor fuel sales taxes. Their rates varied from three cents to nine cents a gallon. The rates also varied among the types of fuel, and they depended, in some cases, on the number of axles on the vehicle in which the fuel was to be used.

CHARLES J. GAA

See also **ROADS AND HIGHWAYS** (How Roads and Highways Are Paid For).

GASPAR. See **MAGI**.

GASPÉ, *GAS* pay, or *gas* PAY, **PENINSULA** is the mountainous southeastern part of the province of Quebec. It lies south of the Saint Lawrence River and reaches the Gulf of Saint Lawrence north of Chaleur Bay. For location, see **QUEBEC** (color map). Gaspé Peninsula is 150 miles long and from 70 to 85 miles wide. It has 450 miles of coast line and covers more than 11,000 square miles. The highest point is Mount Jacques Cartier (4,160 feet). Fishing villages lie along the northeast and east coast. Many persons in the Chaleur Bay area are farmers or lumbermen. Matane is a shipping port on the Saint Lawrence River. Murdochville is a copper-mining region.

M. G. BALLANTYNE

GASTON, WILLIAM (1778-1844), was an American jurist and advocate of political rights for Negroes and Roman Catholics. He served with distinction as a Federalist in the North Carolina Senate and in the United States House of Representatives. A Catholic, he helped persuade North Carolina to give the vote to Roman Catholics. In 1832, Gaston expressed the hope that slavery would be abolished. As a justice of the Supreme Court of North Carolina, he declared that free Negroes were citizens of the United States. Gaston was born at New Bern, N.C.

LOUIS FILLER

GASTRIC JUICE. See **DIGESTION** (From Mouth to Stomach).

GASTRIN. See **GLAND** (Hormones of Stomach and Intestines).

GASTRITIS, *gas* TRY tis, is an inflammation of the stomach. The two common forms of gastritis are called *acute* and *chronic*. Acute gastritis may be caused by poisons such as carbolic acid, iodine, arsenic, rat poison, and bichloride of mercury. The suitable antidote for each poison should be given, and the stomach should be pumped out and thoroughly washed. In poisoning by mineral acids and alkalies, the antidotes should be given, and vomiting should be induced. The stomach should not be pumped out. In all forms of acute gastritis, the patient should eat nothing. See **ANTIDOTE**.

Doctors do not know the cause of chronic gastritis but the condition is serious, because it may lead to cancer of the stomach. See also **DISEASES OF CHILDREN** (table).

PAUL R. CANNON

GASTROPOD. See **MOLLUSK**.

GASTROSCOPE, *GAS* troh skohp, is a flexible tube used to see the inside of the stomach. The tube is about

GATES, HORATIO

2½ feet long and about as thick as a pencil. It has a soft tip which contains a tiny electric light bulb. Eyelets and lenses inside the tube carries the view of the stomach wall to the eyepieces.

In a gastrosopic examination, the doctor first sprays the patient's throat with a local anesthetic, and then siphons out the stomach contents. The patient lies on his left side, because this position affords the best view of the stomach. After the tube has been swallowed, the doctor pumps air through it into the stomach, until the stomach walls are in focus in the eyepieces.

The gastroscope shows things the X ray cannot see, and helps the surgeon decide whether an operation is needed. Tumors, ulcers, and inflammatory areas show up against the contrasting orange-red of the healthy stomach. Cancer may show white or greenish spots. A large percentage of all cancer occurs in the stomach, and doctors use the gastroscope most often to detect early signs of this disease.

JOHN L. LAVAN

GASTRULA, *GAS* troo luh, is the stage of an embryo when it has developed into a sac with walls made of two cell layers, the inner *hypoblast* and the outer *epiblast*. The gastrula forms from the ball-like *blastula* stage that has a single cell layer. See also **EMBRYO**.

GATES, ARTHUR IRVING (1890-), an American educator, became well known for his contributions to the improvement of reading. In 1917, he began teaching at Teachers College, Columbia University. He later served there as director of educational research, executive officer of the department of educational psychology, and head of the department of educational research. Gates was born in Red Wing, Minn. He wrote *Principles of Education* (with E. L. Thorndike, 1929) and *Improvement of Reading* (1936).

JOHN S. BRUBACHER

GATES, DORIS (1901-), is an American writer for children. She was born in the Santa Clara Valley in California, and used the valley as the setting of her first book, *Sarah's Idea* (1938). It tells of a girl who grew up on a prune ranch. For 15 years, Miss Gates was head of the children's department of the Fresno County Free Library. Her most famous book, *Blue Willow* (1940), tells of the dignity and courage of migratory farm workers. Miss Gates' other books include *My Brother Mike* (1948) and *Little Vic* (1951), which won the 1954 William Allen White Children's Book Award.

GEORGE E. BUTLER

GATES, HORATIO (1728?-1806), was an American Revolutionary War general. He received credit for compelling the British general, John Burgoyne, to lay down his arms at Saratoga in 1777.

Gates was born in England, and entered the British Army as a boy. With George Washington, he survived General Edward Braddock's defeat in 1755, and served in America through the French and Indian War (see **FRENCH AND INDIAN WARS**). In 1761, he served with General Robert Monckton at the conquest of Martinique. Gates retired from the army in 1765.

At the beginning of the Revolutionary War, Congress named Gates adjutant general, and he took command of the American Army of the North. After Saratoga, in the winter of 1777-1778, some, including members of the Continental Congress, wanted Gates to replace Washington as commander in chief. It has been claimed that there was a plot called the Conway Cabal to force



Chicago Historical Society

Horatio Gates, an American general, defeated Burgoyne's forces during the colonial struggle for independence.

the change (see CABAL). Washington kept his command, however, and Gates joined him on the Hudson River in 1779. Gates became president of the Board of War, and in 1780 he took command in the South. Cornwallis almost destroyed Gates' army at Camden, S.C., in August, 1780. General Nathanael Greene replaced Gates in December. Congress ordered an inquiry into Gates' military conduct, but it was not made. Gates again served under Washington, and returned to his estate after the war. Later, he freed his slaves and moved to New York to live.

JOHN R. ALDEN

See also REVOLUTIONARY WAR IN AMERICA (Defeat at Saratoga; The War in the South).

GATEWAY AMENDMENT. See ILLINOIS (Constitution).

GATEWAY STATE. See OHIO.

GATH was one of the five chief cities of the Philistines. It was the home of the giant Goliath, whom David killed with a sling shot (I Samuel 17). The king of Gath later gave David a village for his men. Gath lay inland in the southern part of the coastal plain of Palestine. See also GOLIATH; PHILISTINE.

GATLING, RICHARD JORDAN (1818-1903), was an



Richard Gatling, left, invented one of the first successful machine guns. One of the early Gatling guns, right, fired about 600 rounds a minute. The United States Army used it in the Civil War and in the Spanish-American War.

Brown Bros.

American inventor. He spent most of his life improving agricultural methods, but is best known as the inventor of the Gatling gun. His gun was the first practical, quick-firing machine gun developed in the United States. Patented in 1862, it was used only to a limited extent during the Civil War. But improved models became standard equipment for the U.S. Army and Navy in the Spanish-American War. Gatling also invented agricultural machinery. He was born the son of a planter in North Carolina.

CHARLES EDWARD CHAPEL

GATLING GUN. See GATLING, RICHARD J.; MACHINE GUN (History; picture).

GATT stands for General Agreement on Tariffs and Trade. See TARIFF (The Politics of the Tariff).

GATTI, *GAH tee*, **ATTILIO** (1896-), led more than 10 scientific safaris into the African jungles to photograph rare animals where they live and to capture specimens for zoos. Manufacturers paid him to find out how products ranging from plastics to typewriters would withstand the hardships of jungle life. Gatti wrote many books. One of his children's books is *Kamanda, an African Boy* (1941). His books for adult readers include *South of the Sahara* (1945). He was born in Italy.

EDWIN H. CADY

GATTI-CASAZZA, *GAT ee kuh ZAHHT suh*, **GIULIO** (1868-1940), directed the Metropolitan Opera Company in New York City from 1908 to 1935, leading it to artistic and financial success. He was born at Udine, Italy, and studied at the universities of Ferrara and Bologna, and at the Genoa Naval Engineering School. From 1898 to 1908, Gatti-Casazza served as the director of the opera at La Scala in Milan.

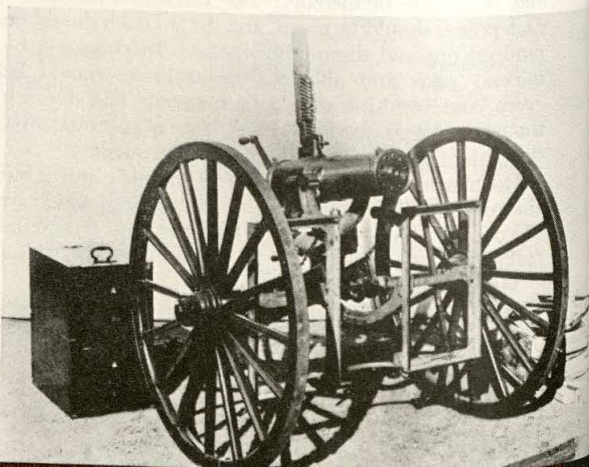
DAVID EWEN

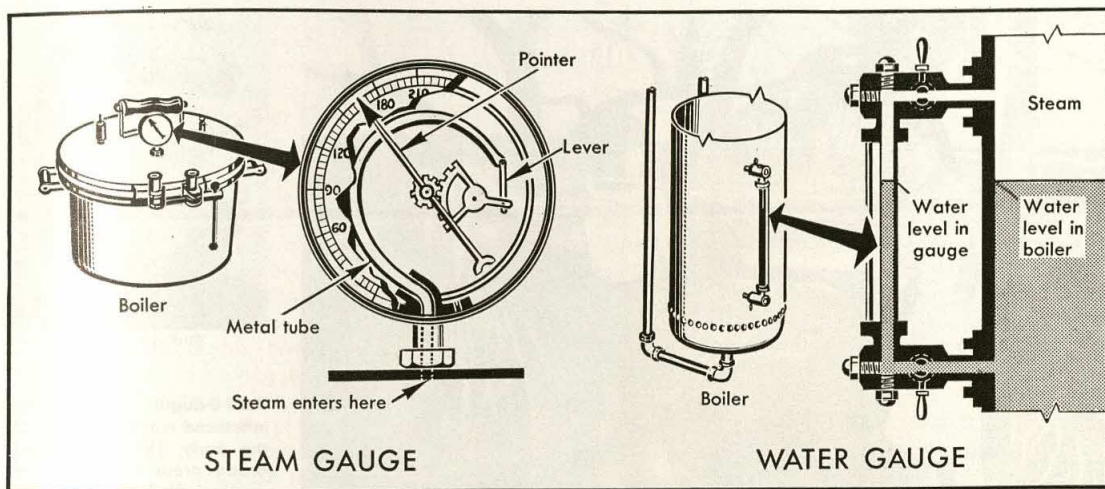
GATUN, *guh TOON*, **LAKE** is an artificial body of water, 85 feet above sea level, created in 1912 by damming the waters of the Chagres River on the Isthmus of Panama. The Panama Canal crosses Gatun Lake through the Gatun locks on the west side of the lake. Gatun Lake covers an area of 163.38 square miles. A narrow strip of land on the north separates it from the Caribbean Sea. The lake has a rugged coast line and contains many islands. Its water provides part of the route for the Panama Canal, and is also used to operate the locks. Gatun Dam, 115 feet high, formed the lake. See also PANAMA CANAL (Gatun Lake). LOYAL DURAND, JR.

GATUN LOCKS. See PANAMA CANAL.

GAUCHO, *GOW choh*, is the cowboy of the South American pampas, or plains. Gauchos played an important part in the development of Argentina and Uruguay. *Peons* (day laborers) have largely taken the place of the gauchos.

The gaucho was usually of mixed Spanish and Indian blood. He was a skillful rider, and spent most of his





time on horseback. His costume was characterized by a wide silver belt, baggy trousers, and a bright scarf. In the early days the gaucho made his living by catching wild cattle and selling their hides in illegal trade on the Brazilian frontier. Sometimes he worked for a while on a cattle ranch, or *estancia*. His weapon was the *bola*, a type of sling. See SLING (Bolas).

The coming of the refrigerator ships led to development of the meat industry. This made cattle raising a big business, and ended the gaucho's way of life. Argentine and Uruguayan writers and musicians have found the gaucho tunes and legends a rich source of material for their works.

MADALINE W. NICHOLS

See also ARGENTINA (picture, Argentina Ranks Among the World's Great Sheep Producers); COWBOY.

GAUGE, or **GAGE**, *gayje*, is an instrument used for measurement. Gauges are used to measure such quantities as pressure, temperature, water level, and thickness. Two of the most common types of gauges are pressure gauges and water-level gauges. But people working in a great many different fields commonly use other kinds of specialized gauges in their work.

Pressure Gauges measure pressure in enclosed vessels or containers, such as boilers or pipes. Two units of pressure are generally used. For pressure greater than that of the atmosphere, most gauges use pounds per square inch (psi). The unit of pressure measurement of pressure below that of the atmosphere is usually given as inches of mercury.

A pressure gauge consists of a tube with a cross section shaped like an ellipse (see ELLIPSE). This tube is called a *Bourdon tube*. It is bent in a hook-shaped curve. When the pressure inside the tube becomes greater than the pressure outside the tube, the elliptical cross section tends to become circular. At the same time, the pressure tends to straighten the Bourdon tube. Levers, gears, or other mechanisms transfer this motion to a pointer. The pointer then rotates around a fixed dial calibrated in pressure units.

Vacuum Gauges measure pressure below that of the atmosphere. They are constructed in the same manner as the gauges described above. However, when the pressure inside the Bourdon tube becomes less than the pressure outside the tube, the tube has a tendency to

curl. This motion is also transmitted to a pointer that moves across a dial. Such dials are calibrated in inches of mercury.

Water-Level Gauges usually consist of a glass tube connected to the side of a container. The level of the water in the container and the level of the water in the tube are the same. Markings on the tube indicate the height of water in the container.

Other Types of Gauges. *Wire* gauges are used to measure the thickness of wire. *Thickness* gauges are used by automobile mechanics to determine the clearance between the pistons and cylinders of automobile engines in thousandths of an inch.

OTTO A. UYEHARA

See also AIRCRAFT INSTRUMENTS; BAROMETER; MICROMETER; PRESSURE.

GAUGE is the size of certain things. See RAILROAD (Gauge); SHOTGUN; STOCKINGS; WIRE (Sizes of).

GAUGUIN, *goh GAN*, PAUL (1848-1903), was one of the most significant French artists of the late 1800's. A painter, wood carver, and ceramicist, he was one of the pioneers of Post-Impressionism.

Gauguin was a master of color composition. His paintings show heavy contours, a moderate distortion of nature, and broad areas of striking shades of rather flat, clear colors. His sense of color and its effective combination as pattern on the surface of a picture made his art highly decorative. It eventually brought him a reputation as one of the leading masters of the last 100 years.

His Early Life. Gauguin was born EUGÈNE HENRI PAUL GAUGUIN in Paris. He spent four years of his childhood in Peru. He worked for a while as a sailor, and then became a successful stockbroker. He married a Danish woman, and they had five children. In 1884, he gave up his business to become a painter. For some time he had been an amateur, but now art became the driving force in his life. He left his wife, and supported himself by doing odd jobs. He became difficult and self-centered, but this egoism helped him to keep on painting despite poverty, neglect, and illness.

The bright colors and free brushwork of Impressionism marked his earliest style. He completed his first major works in Brittany, chiefly in the neighborhood of Pont-Aven. During this period, the flat areas and strong



Minneapolis Institute of Arts



Historical Pictures Service

Paul Gauguin, above, greatly influenced modern painting of the early 1900's. He used broad areas of purple and orange in *Under the Pandanus*, left, done in Tahiti in 1891.

contours of Gauguin's mature style began to appear.

In 1887, Gauguin sailed to Panama, where he worked as a laborer on the canal. He later went to Martinique. Illness forced him to return to France, where he stayed for three years. After a small exhibit of his work in 1888, he went to Arles in southern France, where he worked briefly with his friend Vincent van Gogh (see VAN GOGH, VINCENT).

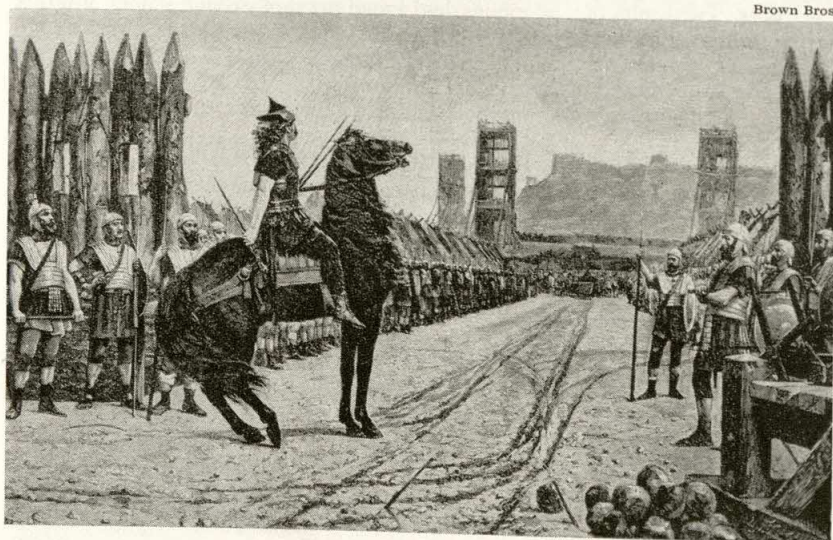
Leaves Europe. In 1891, Gauguin decided to escape European civilization. He sought a primitive location where he could live and paint undisturbed by the narrow conventions of European society. An auction of his work provided some funds, and in 1891 he sailed for Tahiti. There he found a measure of rest, the simple surroundings, and the color he needed for his increasingly vivid, colorful paintings. But his health was not good, and the paintings he sent to Paris did not sell.

He returned to France, but soon went back to the South Seas to stay. He painted some of his finest pictures in his last years. A picture from this period, *Ta Matele*, appears in color in the PAINTING article. Gauguin died desperately poor, in the Marquesas Islands, in 1903.

JOSEPH C. SLOANE

GAUL, *gaul*, is the English name for the region called *Gallia* by the Romans. Gaul occupied all the territory now included in France and extended eastward a little way beyond the French border. In early Roman times, tribes known as the Belgae, the Aquitani, and the Celtae, or Galli, inhabited this region. All three groups were sometimes called Gauls. The Romans spoke of "long-haired Gauls," because the Gauls did not shave their beards or cut their hair.

In 390 B.C., Gallic tribes crossed the Alps, swept down through Italy, and sacked and burned Rome.



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The Great Gallic Leader, Vercingetorix, left, surrendered to the Roman general Julius Caesar in 52 B.C., at Alesia in central Gaul. The map, below, shows the boundaries of Gaul at the height of the Roman Empire, about A.D. 115.



The Romans drove them back, but for a time they held the northern part of the Italian peninsula. The region south of the Alps became known to the Romans as *Cisalpine Gaul*, or *Gaul this-side-of-the-Alps*. They called the region north of the Alps *Transalpine* or *beyond-the-Alps* Gaul. In the 200's B.C., Gallic tribes invaded Thrace and Macedonia and finally Asia Minor. Here they became known as Galatians (see GALATIA).

The Gauls were brave and warlike, but they proved no match for organized Roman armies. The Romans began to force them farther and farther north and finally out of Italy. Those Gauls who remained became peaceful citizens of Rome. Then the Roman invasions of Transalpine Gaul began. The Romans succeeded during the 100's B.C. in gaining mastery of the strip of Gaul along the Mediterranean Sea. This region is now known as *Provence* from the Latin *provincia*, meaning *province*. The Romans did not conquer all Gaul until the time of Julius Caesar. He waged a number of campaigns between 58 and 50 B.C. He told the story of these campaigns in his *Commentaries on the Gallic War*.

The Emperor Augustus organized Gaul into four provinces for purposes of administration. This form of organization lasted for 400 years. Gaul later suffered heavily through civil wars and barbaric invasions. But it passed on a rich cultural tradition to its new masters. Chief among the invaders were the Franks, who came in the late A.D. 400's. From that time, most of Gaul was called *France*, after the Franks. Other regions kept the names of ancient inhabitants.

WILLIAM C. BARK

See also CAESAR, GAUL JULIUS.

GAULEITER, *GOW LY tur*, was the political leader of a district in Nazi Germany. The Nazi government divided Germany into 42 political districts, or *gaue*. The *gauleiter*, or district leader, exerted great power over the people who lived in his *gau*. During World War II, the title *gauleiter* denoted many of the governors in occupied countries.

GAUNTLET, *GAWNT let*, is a heavy leather glove, covered with little plates of iron. Armored knights and soldiers of the early 1200's usually wore these gloves. In addition to being a part of the armor, the gauntlet was used to challenge the enemy.

When a man thought that someone had wronged or insulted him, he threw down his gauntlet. His enemy picked it up, as a sign that he accepted the challenge to fight. Then the two men arranged the time for their battle. They fought the battle under strict rules, and it took the place of a legal trial.

People in those days believed that God gave the innocent person strength to defeat the guilty. They thought that whoever won the battle had proved himself right. The expression *throw down the gauntlet*, meaning *to declare a chal-*

lenge, comes from this medieval custom. Any glove with a long, loose cuff is called a gauntlet. ROBERT COLBORN

GAUR, *gour*, is a wild ox of India, Burma, and the Malay Peninsula. Bull gaurs stand 5 to 5½ feet tall at the shoulder and weigh over a ton. Gaurs have short dark brown hair. Both males and females grow long, curved horns that become heavy and sharp. Gaurs live in forests, usually in rocky hill country. Their active sweat glands give them a strong cattle smell and also keep their coats smooth and shiny.

Scientific Classification. The gaur is in the family *Bovidae*. It is genus *Bibos*, species *gaurus*. VICTOR H. CAHALANE

See also ANIMAL (color picture, India, South Asia, and East Indies); Ox.

GAUSS, *gous*, is a unit used to measure the strength of a *magnetic field*, the space around a magnet where its effects are felt. The gauss is named for Karl Friedrich Gauss, a German mathematician, who did important work in electromagnetism. The earth's magnetic field is relatively weak. It measures only about ½ gauss. The magnet of a cyclotron, a type of atom smasher, may have a strength of 20,000 gauss.

IRA M. FREEMAN

GAUSS, *gous*, **KARL FRIEDRICH** (1777-1855), a German mathematician, was one of the greatest mathematicians of all time. He was a child prodigy, and completed his first original work at 19 when he showed how to construct a regular 17-sided polygon with a ruler and compasses. He also became famous for work in number theory, geometry, and astronomy, and for proving "the fundamental theorem of algebra," which states that every algebraic equation has a root. He invented a telegraph, and made important contributions to the mathematical theory of electromagnetics. The *gauss*, an electromagnetic unit of magnetic induction, is named for him.

Gauss was born in Brunswick, the son of a bricklayer, and attended the University of Göttingen. He served as director of the Göttingen observatory. PHILLIP S. JONES

GAUTAMA BUDDHA. See BUDDHA.

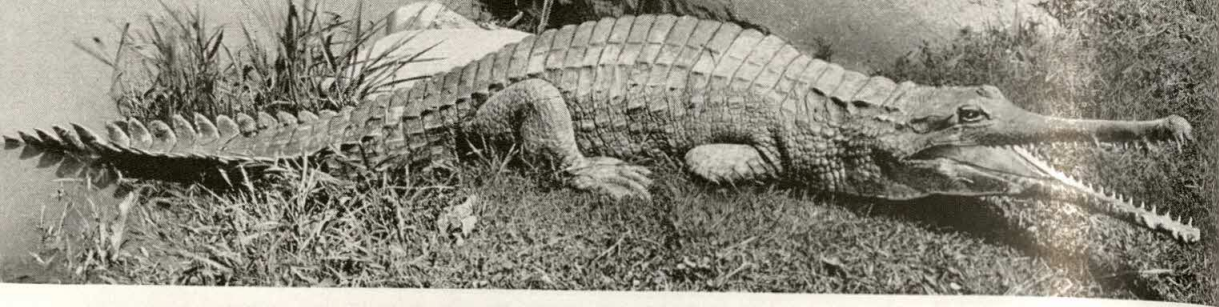
GAUZE, *gauz*, is a thin, open cloth made of cotton, silk, or rayon. Gauze probably takes its name from the ancient city of Gaza in Palestine, where this type of cloth was first made. The threads are woven in a special way called *leno*, or *gauze*, weaving. In leno weave the threads which run lengthwise on the loom, or *warp* threads, are always in pairs. The pairs of lengthwise threads are twisted together each time they are crossed by the crosswise, or *weft*, yarns. In this way, the threads are kept at an equal distance apart, but still are held in place. Leno weave is also used in making mosquito netting, marquisettes, and the *bolting cloth* with which flour is sifted in mills. Surgical, or hospital, gauze is a cheesecloth in a plain weave. The name gauze is also given to various sheer curtain fabrics in silk, rayon, or nylon. See also MOSQUITO NETTING. GRACE G. DENNY

GAVARNIE FALLS, *gah vahr NEE*, in southwestern France, plunges 1,385 feet from a glacier to the floor of a steep recess in the Pyrenees Mountains. This recess, known as the *Cirque de Gavarnie*, lies more than 5,000 feet above sea level (see GLACIER [Erosion]). The water falls only in summer after the sun has melted part of the glacier. It tunnels through masses of snow and reaches the Gave de Pau River.

ROBERT E. DICKINSON

Steel Gauntlets were used by duelers in the 1600's.
The George F. Harding Museum





N.Y. Zoological Society

The Long-Snouted Gavial of Asia Is Not Dangerous to Human Beings in Spite of Its Fierce Appearance.

GAVIAL, *GAV* vih ul, is a reptile much like a crocodile, except that it has an extremely long and narrow snout. It lives in Burma and northern India. The gavial is one of the reptiles called crocodilians, but has no near relatives among them. It grows to be 20 feet long or more. But people do not fear it much, because its chief food is fish. Its long snout and many teeth are handy for catching fish. The gavial lays 40 or more eggs, and buries them in sandbanks. The young reptiles hatch in March and April, and are about 15 inches long.

Scientific Classification. The gavial belongs to the family *Gavialidae*. It is classified as genus *Gavialis*, species *gangeticus*.

CLIFFORD H. POPE

See also CROCODILE.

GAVOTTE. See DANCING (During the 1600's).

GAWAIN, SIR. See ROUND TABLE.

GAY, JOHN (1685-1732), was an English poet. His best-known work, *The Beggar's Opera* (1728), is a hilarious take-off on Italian opera, and, at the same time, a serious criticism of London life. This rollicking piece has often been revived. *The Threepenny Opera*, a contemporary musical play by Kurt Weill and Bertolt Brecht, is based on it. Gay was born at Barnstaple. His friends included the writers Alexander Pope, Joseph Addison, and Jonathan Swift. Gay was buried in Westminster Abbey. Pope wrote his epitaph, which is followed by Gay's own couplet:

Life is a jest; and all things show it,
I thought so once; but now I know it.

GEORGE F. SENSABAUGH

GAY-LUSSAC, *luh SACK*, **JOSEPH LOUIS** (1778-1850), was a French chemist and physicist. In 1802, he discovered a law, sometimes called *Gay-Lussac's law*, which deals with the effects of temperature on gases (see GAS [Charles' Law]). He studied the chemistry of gases and, in 1809, summarized the work of others in the *Law of Combining Volumes*. This law states that gases form compounds with each other in simple, definite proportions. These proportions can then be expressed in formulas. The formula used for water (H_2O), for example, shows that it is formed of two parts of hydrogen (H) and one of oxygen (O).

Joseph Louis Gay-Lussac
Brown Bros.



Gay-Lussac investigated the upper atmosphere. He rose 21,000 feet above sea level in a hydrogen-filled balloon to collect samples of air to find out the com-

position of air and to observe its temperature and moisture. He improved the processes for making sulfuric acid and oxalic acid for industry. He suggested a method of determining the amount of alkali in potash and soda, and improved ways of estimating the amount of chlorine in bleaching powder. He discovered cyanogen in 1815 (see CYANOGEN). Gay-Lussac was born at St. Léonard-le-Noblat.

CARL T. CHASE

GAYARRÉ, CHARLES ÉTIENNE ARTHUR. See LOUISIANA (Famous Louisianians).

GAYNOR, WILLIAM JAY. See NEW YORK CITY (Famous New Yorkers).

GAZA, *GAY* zuh (pop. 100,000) is the capital and largest city of the Egyptian-administered Gaza Strip. The city lies about 3 miles from the Mediterranean Sea, and about 50 miles southwest of Jerusalem. For location, see ISRAEL (color map). Until 1948, the Gaza Strip formed part of Palestine. The Bible mentions Gaza as the place where Samson destroyed the temple of Dagon. The thin, open cloth called *gauze* was probably first made in the city.

ALEXANDER MELAMID

See also GAUZE; SAMSON.

GAZA STRIP. See ISRAEL (History; color map).

GAZELLE, *guh ZELL*, is a small, slender antelope noted for its beauty, grace, and gentleness. Poets have often written about these qualities of the gazelle. About 25 different kinds, or species, of gazelle live over a wide area of tropical Africa and Asia. Some live in mountain ranges, and others on sandy plains.

Gazelles have large, soft, black eyes. Both males and females of most species have round black horns. The horns of some types have ringlike ridges around them, but others are smooth. Usually the horns are U-shaped. They have long, narrow, pointed ears, and short tails. A gazelle's hair is short and smooth. Some gazelles have tufts of hair on the knees. One well-known type of gazelle has a light fawn-colored back that deepens to a wide band of dark brown along the flanks. This band forms a line between the upper part of the body and the pure white underside.

Gazelles are swift runners. Not even the swiftest greyhounds can always run as fast as gazelles. Men often use falcons to hunt them, or build enclosures to trap them near places where they go to drink.

Gazelles are plant-eating animals. *Loder's gazelle* lives in the Sahara and eats berries and leaves. The Arabs believe it never drinks.

The familiar light-brown gazelle, sometimes called the *dorcas* or *ariel gazelle*, is about 2 feet tall. It lives in the desert where only a few low shrubs grow, and is a favorite pet of wandering Arabs. The name *gazelle* comes from an Arabic word that means to be affectionate.

Grant's gazelle has longer horns than any other kind.

The horns of an ordinary gazelle are 10 to 15 inches long, but those of Grant's gazelle may grow 30 inches or longer. This animal stands 32 to 34 inches high at the shoulder. It lives in herds of 6 to 20 or even as many as 200 animals. Grant's gazelles often graze with hartebeests and zebras. Another gazelle is the light chestnut-colored *chikara*, or *ravine deer*, of India and the plains of Asia. The *springbok* of South Africa was numerous before the hunters came. Like other gazelles, it has been killed by men and animal enemies.

Scientific Classification. Gazelles belong to the family Bovidae. They are genus *Gazella*. VICTOR H. CAHALANE

See also ANTELOPE.

GAZETTE. See NEWSPAPER (Newspaper Terms).

GAZETTEER. See DICTIONARY (Specialized).

GDANSK. See DANZIG.

GÊ INDIANS, *zhay*, formed a large group of related tribes that once lived in the dry upland plains of eastern Brazil. People once thought them to be the most primitive Indians of South America. They did not wear clothes, make pottery, or use canoes. But they developed a complex social organization.

The Gê farmed. Sweet potatoes and yams formed their basic diet. They hunted expertly. The Gê decorated their bodies with paint and feathers. Many of the men wore big wooden earplugs, 3 or 4 inches wide.

Gê villages were large, and housed from 400 to 800 people. The houses stood in a circle. A path that ran around them served as a track for the people's favorite sport, foot racing. As the team members ran in the races, they carried logs about 3 feet long and 20 inches thick that weighed as much as 200 pounds. The teams were made up of the members of the various clans, clubs, and other groups that existed in each village. These same groups also cooperated to make gardens, go on war parties, and organize festivals.

A few Gê tribes, called Kayapó, still live in a little-explored region between the Araguaia and the Xingú rivers in Brazil. They are among the world's last, untouched primitive people.

CHARLES WAGLEY

GEAR

GEAR, *geer*, is a mechanical device that transfers rotating motion and power from one part of a machine to another. One of the most common gears is called a *spur gear*. It is a metal wheel or disk with slots, called *teeth*, around the edge. The teeth of one gear are fitted into the teeth of another gear, so that when the first gear turns the second turns with it. Metal rods, or *axles*, are fitted into the center of each gear. One axle runs to the source of power. When the power axle turns, its gear turns and causes the second gear to turn, which makes the second axle turn.

When the gearing between two parts of machinery is disconnected, the machine is said to be *out of gear*. Automobiles are put out of gear by moving the gear shift to the *neutral* position. This action slides the gears on one shaft away from the gears on the drive shaft so that the contact is broken, and the automobile does not move, even though its motor is running.

Reducing and Multiplying Gears. Gears may be used to increase or decrease either turning effort or speed. A gear that slows down the speed it transmits is called a *reducing gear*. The gear connected to the power shaft is smaller than the gear its teeth are *meshed* with. Therefore, while the smaller power gear turns once, the large gear turns less than once. If the circumference of the power gear is 6 inches and the circumference of the other gear is 12 inches, the large gear turns only once while the power gear turns twice. The speed is cut in half, but the *torque*, or turning effort, is doubled (see **TORQUE**). *Low gear* on an automobile reduces motor speed to get increased driving force, which overcomes the stationary automobile's inertia, and starts its wheels turning.

Gears that increase the speed are called *multiplying gears*. The power gear is now the large gear. If it is 12 inches in circumference and the other gear is 6 inches, the power gear turns only once to make the second gear turn twice. The speed is doubled while the

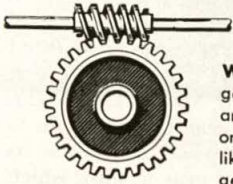
Ylla, Rapho-Guillumette

The Graceful Gazelle has large, soft eyes and ridged horns. It is found throughout a wide area of tropical Africa and Asia. Some gazelles live in high, rugged mountains, while others live on the plains.



TYPES OF GEARS

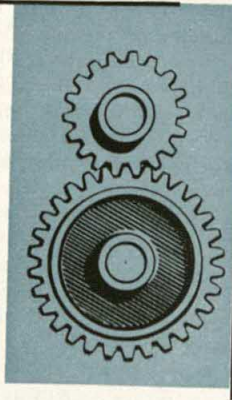
WORM GEAR



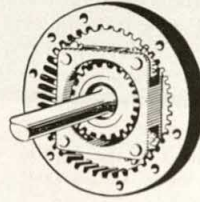
Worm Gears have one wheel gear similar to a spur gear, and one endless screw around one of the axles. The spur-like gear meshes with the screw gear at right angles.

SPUR GEAR

Straight Tooth Spur Gears usually connect parallel shafts, which then rotate in opposite directions. When the power shaft turns its gear, the second gear and shaft also turn.



PLANETARY GEAR



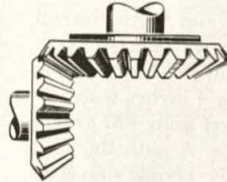
Planetary Gear Trains use a combination of gears to transmit power. A central sun gear meshes with planetary pinions around its circumference, and they mesh with the outer wheel.

HELICAL GEAR



Helical Gears are similar to spur gears. They differ in that the teeth are of helical, or screw, form. This tooth form makes the gear operation quieter at high speeds.

BEVEL GEAR



Bevel Gears mesh at right angles to each other, an arrangement which changes the direction of the power. The edges and teeth of the circular gears also slant at angles.

turning effort, or torque, is reduced. *High gear* in some automobiles is a multiplying gear.

Types of Gears include bevel gears, worm gears, helical gears, friction gears, and planetary gears. *Bevel gears* are circular and have toothed edges, but the edge and the teeth slant at angles. When two bevel gears are meshed, the motion between the two gears is transferred at a different angle, usually a right angle. *Worm gears* have one gear similar to a spur gear, and an endless screw around one of the axles. The spurlike gear is meshed with the screw gear, and the axles are at right angles. *Helical gears* are similar to spur gears, except that the teeth run at an angle to the shaft, rather than parallel with the shaft. Helical gears are sometimes called *spiral gears*, even though the teeth are not spiral-shaped.

Friction gears do not use teeth. Instead, they use a shaft-driven wheel that presses against another wheel and causes it to turn. Friction gears provide uniform power, but not as much power as toothed gears. Automatic automobile transmissions use *planetary gear systems*, which consist of *planet*, or *pinion*, gears that rotate around a *sun*, or central gear, in much the same way that planets rotate around the sun (see TRANSMISSION [Automatic Gear Transmission]).

E. A. FESSENDEN

See also AUTOMOBILE (From the Engine to the Rear Wheels); DIFFERENTIAL; MACHINE.

GEBER, *JEE ber*, or **JABIR**, *JAH bir*, **IBN-HAYYAN** (721?-776?), was an Arabian alchemist (see ALCHEMY). His writings influenced chemistry as late as the 1400's. Geber appreciated the value of experimental work, and is believed to have discovered sulfuric acid and nitric acid. He believed that metals were composed of one

basic element, and that transmutation of metals was possible (see TRANSMUTATION OF ELEMENTS). He was born at Tus, Persia (now Meshed, Iran).

PAUL R. FREY

GECKO, *GEHK oh*, is the name of certain small lizards that live in warm climates. Geckos have short, flat bodies covered with tiny scales. The feet of most geckos are formed for holding to smooth surfaces. Each toe ends in a pad and a hidden claw. These toe pads, made up of thousands of tiny hooks, allow the animal to cling to surfaces that look smooth. The claws can be moved out like those of a cat, and are used on rough surfaces. Most geckos come out at night. They feed chiefly on insects. They are named for the loud call that many kinds of geckos make.

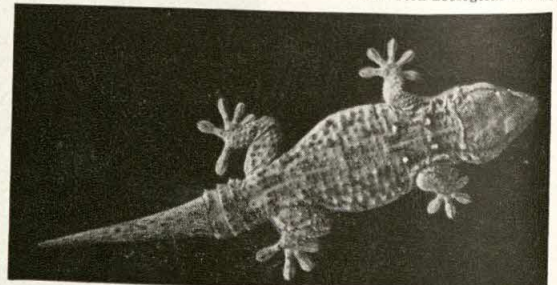
Scientific Classification. Geckos make up the family Gekkonidae.

CLIFFORD H. POPE

See also LIZARD.

Most Geckos can walk easily on an upright pane of glass. The bottom of each toe has an adhesive pad that enables geckos to cling to surfaces which appear smooth.

New York Zoological Society





Wide World
Norman Bel Geddes

GEDDES, GEHD *ihz*, **NORMAN BEL** (1893-1958), was an American designer and producer. He first attracted attention as a designer of stage settings and producer of plays. He designed settings for more than 200 plays and for several unusual theater buildings. Among the plays were *The Miracle* (1923) and *Dead End* (1935). Later, he pioneered in industrial design, and designed the first streamlined ocean liner

and the "Futurama" at the New York World's Fair of 1939 and 1940. Norman Bel Geddes was born in Adrian, Mich.

BARNARD HEWITT

GEESE. See **GOOSE.**

GEGENSCHEIN, GAY *gun SHINE*, is a faint glow of light that appears as a comparatively bright oval spot in the zodiacal light (see **ZODIACAL LIGHT**). It is always exactly opposite the position of the sun. Gegenschein is also called *counterglow*.

GEHENNA, *gee HEN uh*, was the valley of Hinnom, southwest of Jerusalem. Its name comes from two Hebrew words, *gai* and *Hinnom*, meaning *valley of Hinnom*. Sacrifice of children, called Moloch worship, took place there during the reign of Manasseh, King of Judah in the 600's B.C. The recollection of these hideous events caused the valley to become a symbol of the torment of the damned (Isaiah 66:24). Gehenna became a synonym for hell in Jewish, Islamic, and Christian (Mark 9:47) tradition.

CYRUS H. GORDON

See also **HELL**; **MOLOCH**.

GEHRIG, "LOU," HENRY LOUIS (1903-1941), was one of the greatest of America's professional baseball players. He is remembered for playing 2,130 consecutive games in 14 seasons with the New York Yankees. Gehrig compiled a lifetime batting average of .340, and batted in 150 or more runs in seven different seasons. He retired in 1939 because of illness. He later served as a member of the New York City Parole Commission. Gehrig was born in New York City.

ED FITZGERALD

GEIGER, GUY ger, ABRAHAM (1810-1874), was a Jewish theologian and a leader of Reform Judaism. His most important work was done at Breslau, where he organized the Jewish Reform movement. Geiger taught that Judaism must constantly develop and change. His books concerned chiefly Biblical subjects and the history of Judaism. In 1870, he became head of the seminary for Jewish science in Berlin. Geiger was born at Frankfurt am Main, Germany. See also **JUDAISM** (Reform Judaism).

CLIFTON E. OLMSTEAD

GEIGER, GUY guhr, HANS (1882-1947), a German physicist, became famous for his work in nuclear physics. He developed the Geiger counter, used for the detection of radioactivity (see **GEIGER COUNTER**). His work on the deflection of alpha particles by thin metal foils led Ernest Rutherford to discover his model of atomic structure in 1911 (see **ATOM** [Inside the Atom]; **RUTHERFORD, ERNEST**). Geiger was born in Neustadt, Germany. He was Rutherford's assistant from 1906 to 1912.

R. T. ELLICKSON

GEIGER COUNTER

GEIGER COUNTER, or **GEIGER-MÜLLER COUNTER**, is a device used to detect radioactive radiations, such as those given off in the release of atomic energy. The counter is usually in the form of a thin metal cylinder enclosed in a glass tube. The metal wall serves as one electrode. A straight wire projected into the cylinder is the other electrode. The electrodes are maintained at a voltage which is just short of the breakdown potential of the air or other gas in the cylinder. If any other ionizing influence is sent into the cylinder, the gas will ionize. This sets up a weak current. The current is revealed by light signals, by clicks picked up by earphones, or by readings on a meter.

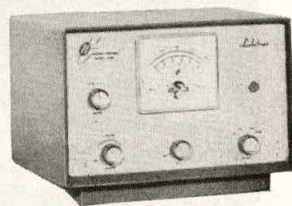
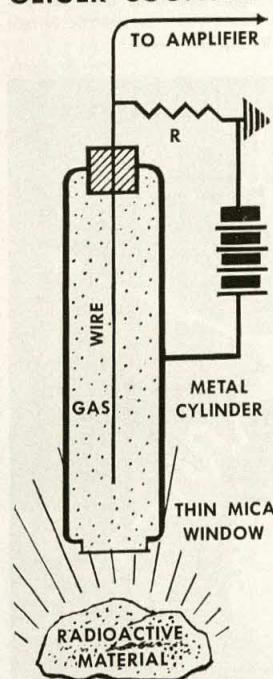
The German physicist Hans Geiger and the British scientist Sir Ernest Rutherford (1871-1937) developed the radiation counter in 1908. Geiger counters in use today are based on designs made by Geiger and W. Müller in the 1920's.

Science and industry use Geiger counters for many purposes, including nuclear research and the location of sources of radioactivity. Some uranium prospectors carry small models as standard equipment.

Geologists and prospectors using Geiger counters to find radioactive materials have found that these instruments are not sensitive enough when used singly. Larger Geiger counters are too large and clumsy for use in the field. As a result, the smaller *scintillation* counter has largely replaced the Geiger counter for survey work. Scintillation counters detect radioactive substances by measuring the *scintillations*, or tiny flashes of light, given off when a phosphor is bombarded by alpha particles from radioactive materials (see **PHOSPHOR**). **MARGEL SCHEIN**

See also **ATOMIC ENERGY**; **COSMIC RAYS**; **GEIGER, HANS**; **RADIOACTIVITY**.

GEIGER COUNTER



Nuclear-Chicago Corp.

The Geiger Counter Tube, left, detects radiation from radioactive materials. Rays enter the thin mica window and ionize the gas in the tube, setting up a current between the wire and metal cylinder, which serve as electrodes. These electrical impulses then pass into a count rate meter, above, where a needle and dial show the average number of counts detected per minute.

GEIKIE, SIR ARCHIBALD

GEIKIE, GEE kih, SIR ARCHIBALD (1835-1924), was a Scottish geologist. He traveled in both Europe and North America, doing field work on glacial and ancient volcanic deposits. In 1855, he joined the Geological Survey of the United Kingdom. He became director-general of the Survey and its Museum of Practical Geology in 1881. His works include *A Textbook of Geology* (1882) and *The Founders of Geology* (1897). Geikie was born in Edinburgh and received most of his scientific education from tutors.

CARROLL LANE FENTON

GEISEL, THEODOR. See SEUSS, DR.

GEISHA. See JAPAN (Ways of Life).

GEISSLER TUBE, GICE lur, is a glass tube used to show the brilliant colors which electricity produces when it passes through gases and partial vacuums. It is similar to a neon light. Heinrich Geissler (1814-1879), a German maker of scientific instruments, first built them.

These hard glass tubes have many different shapes. Each end of the tube has a platinum wire sealed inside. The ends of the wire serve as electrodes. The tubes are filled with rarefied gases such as hydrogen, oxygen, nitrogen, and ordinary air. The wire electrodes are then connected to the opposite poles of an electrostatic machine or an induction coil, and an electric current is passed through the tubes. The different gases produce different colors of light. The color is also affected by the degree of *rarefaction*, or thinness, of the gas.

Geissler tubes are valuable in scientific research. They are used particularly to examine incandescent gases with the spectroscope.

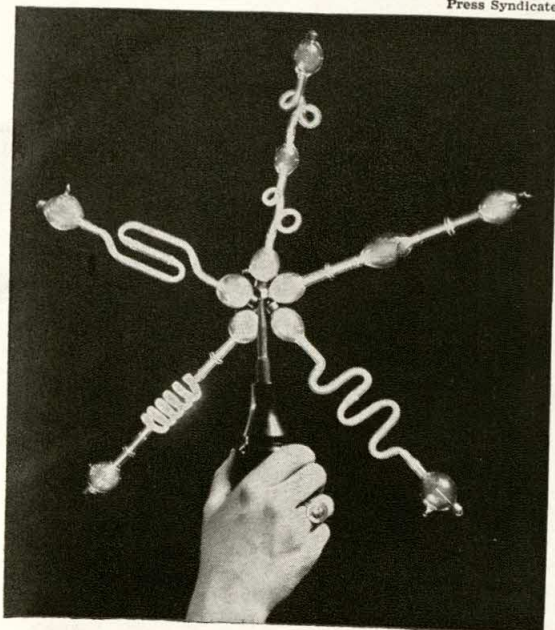
MARCEL SCHEIN

See also SPECTROSCOPE.

GEL, jehl, is a colloid solution stiffened to a jellylike mass. It is also the stiffening process. A colloid is a liquid containing tiny particles that do not settle. When this

Geissler Tubes, like the neon lights commonly used for display, glow with lights of various colors when an electric current is passed through the gases which they contain.

Press Syndicate



mixture coagulates, or turns to a jellylike solid, it is a *gel*. The temperature at which it gels is affected by the presence of salts. See also COLLOID.

GELASIVS, jee LAI sih us, was the name of two popes of the Roman Catholic Church. Both were concerned chiefly with relations between church and state.

Saint Gelasius I (? -496) reigned from 492 to 496. He issued the Gelasian, or two-sword, theory. In this theory, he outlined the separate areas of spiritual and state authority, and insisted that neither should encroach upon the other. He maintained that in spiritual matters a state ruler is subject to the pope. Gelasius' theory dominated the Middle Ages.

Gelasius II (? -1119) reigned in 1118 and 1119 during the controversy over whether state rulers had the right to appoint religious officials. He refused to grant this right to Emperor Henry V, but failed to solve the controversy.

THOMAS P. NEILL and FULTON J. SHEEN

GELATIN, JEHL uh tih, is a protein substance that comes from the skins and bones of animals. Gelatin is hard, tasteless, and odorless. When dry, it appears nearly white. Gelatin dissolved in water is transparent. Gelatin forms a stiff jelly after being dissolved in hot water and allowed to cool.

To manufacture gelatin from the bones of animals, the bones must first be freed from grease. They are then soaked in a hydrochloric acid solution to rid them of minerals, and washed repeatedly in plain water. The cleaned bones are heated in distilled water at a temperature of about 92°F. for several hours. The fluid is then run off, and the bones are reheated in fresh distilled water. This time the heat is a little higher, generally around 102°F. The fluid that forms must be treated with a chemical so that the gelatin will be pure. Finally, the gelatin is concentrated, chilled, and sliced, then dried. The final product is usually ground.

Skin gelatin is manufactured in much the same way as bone gelatin, except that the skin gets a different "preboiling" treatment. A lime treatment removes the grease and other foreign elements in the skin. Then the skin is washed in water, and treated with dilute hydrochloric acid.

Gelatin is important as a food. Its high protein content is particularly beneficial for sick persons and children, because it can be digested easily.

The photographic industry uses gelatin for making the coating on dry plates, films, and photographic papers. Both soft and hard medicinal capsules are made of gelatin, but the soft capsules, used for oils, have glycerin added. Scientists use gelatin as a medium in which to grow bacteria.

C. L. MANTELL

See also DYNAMITE; GLUE; ISINGLASS; PROTEIN.

GELDING. See HORSE (Horse Terms).

GELLÉE, CLAUDE. See LORRAIN, CLAUDE.

GELSEMIUM, jell SEE mih um, or **YELLOW JASMINE, JAS min,** is a climbing shrub that grows in the southern United States. It has shiny, sword-shaped leaves and fragrant yellow flowers that are funnel-shaped and grow in clusters. Its roots produce a powerful and dangerous drug called *gelsemium*. This drug is sometimes used in cases of malaria, rheumatism, and neuralgia.

Scientific Classification. The gelsemium belongs to the family *Loganiaceae*. It is genus *Gelsemium*, species *sempervirens*.

J. J. LEVISON

See also JASMINE.

GEM. In general, all minerals and stones that are used for jewelry and other ornamental purposes are called gems. The word gem comes from the Latin *gemma* meaning *bud*. The story of precious stones is much like that of the blooming of flowers. Like tiny buds that burst into beautiful blossoms, dull lumps of mineral matter can be cut and polished into brilliantly flashing or beautifully glowing gems.

One beautiful gem, the pearl, is not a stone, but is obtained from a mollusk. Amber, another substance used as a gem, is a resin of fossil trees, while coral, which is popular for necklaces, is made by tiny sea animals. Jet is fossilized coal.

Qualities of Gem Minerals

Experts identify different kinds of gem minerals by the shape of the uncut crystals, the color, the index of refraction, hardness, specific gravity, and other physical properties.

Shape of Crystals differs with each gem mineral, but the shape of all crystals in any one mineral is usually the same. For instance, diamonds are usually found in crystals which have six square faces, making a cube, or are eight-sided, like a double pyramid. Other crystals sometimes have 12 faces, with each face forming a parallelogram. See CRYSTAL AND CRYSTALLIZATION.

Color is one of the important factors that determine the beauty and splendor of gems. Opaque or cloudy stones depend on color alone for their beauty, whereas transparent stones of a deep rich color have unusual beauty because of their ability to reflect light. There are two types of colors in gem minerals, essential and non-essential. *Essential* color is the color of the mineral itself, when pure. *Nonessential* color is the result of an impurity in the mineral. Such an impurity is not an important part of the mineral. Since different specimens of a mineral may contain different impurities, each of these specimens may be a different color.

Index of Refraction is the measurement of the speed of rays of light passing through a mineral. When light passes from air to a denser substance, its speed is slowed down, and the ray of light entering at an angle is *refracted*, or bent, at the point of meeting. The ratio of the speed of light in air to its speed in the mineral is the gem's index of refraction. Minerals with a low index of refraction usually display a low luster. The extent of refraction also varies with the color of the light that passes through the mineral. Blue rays are refracted more than yellow, and yellow rays more than red. Beams of white light passed through some stones become separated into various-colored rays. This is called *dispersion*. The degree of dispersion varies with different gems. In

most diamonds, for instance, dispersion is very distinct. When a ray of light is passed through a properly cut diamond, the gem reflects bright flashes of spectral color. See LIGHT (Reflection and Refraction).

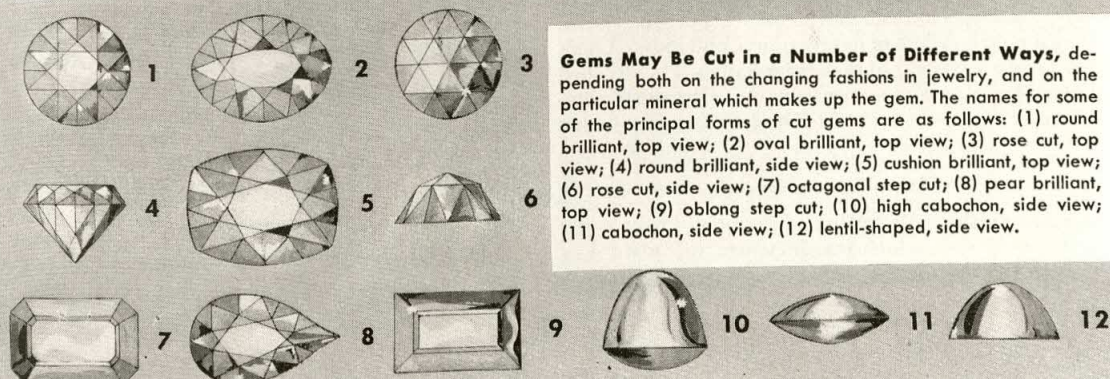
Cleavage is the habit of each type of gem mineral to break or split along a definite atomic plane. This smooth separation differs from a *fracture*, in that the surface resulting from a fracture is always irregular. Possible cleavage directions and types of fractures are characteristic for each mineral.

Hardness is an important quality of gem minerals. Few stones can become valuable gems unless they will wear for a long time. A scale has been set up to indicate the sequence of hardness of each gem mineral. This scale numbers from one to ten. Only minerals with a rating of seven or more wear well as gems. A mineral that has a rating of seven, such as quartz, cannot be cut by a knife, nor can it be scratched by glass. The diamond is the hardest substance in nature, and is number 10 on the scale. It will scratch any of the other minerals.

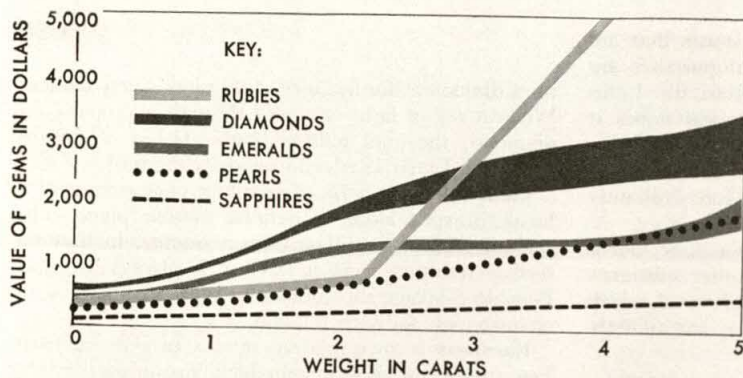
Specific Gravity is a comparison of the weight of the mineral with the weight of an equal amount of pure water. Each gem mineral has its own specific gravity. Light minerals have a low value and heavy ones a high value. For instance, amber weighs about the same as salt water, whereas diamonds weigh about three and one-half times as much as an equal amount of water.

Sources of Gems

The underlying rock type largely determines the kind of gem minerals found in different parts of the world. Climate may also be a factor. Opal and turquoise are found mostly in parts of the world where there is little rainfall. Turquoise is found in great quantities in the American southwest, and in Tibet. Other minerals, such as emerald, topaz, and tourmaline, are found in ancient areas, where erosion has exposed the old, once molten rocks at the surface. Emeralds are found in the Urals and Colombia, as well as in certain parts of South Africa. Topaz was once found in Germany and Russia, but the finest stones come from Brazil. Tourmaline is found in some parts of the United States, and once came from the Ural Mountains, but Brazil, Africa, and Madagascar are today's important localities. Some gem minerals seem to develop only in more recently molten rocks. The diamond pipes, or volcanic plugs, of Africa and peridot are two of these. Most diamonds are now found in Africa. The best rubies are found in Burma, and the best sapphires come from Kashmir. The finest opals come from Australia. The best pearls come from



Gems May Be Cut in a Number of Different Ways, depending both on the changing fashions in jewelry, and on the particular mineral which makes up the gem. The names for some of the principal forms of cut gems are as follows: (1) round brilliant, top view; (2) oval brilliant, top view; (3) rose cut, top view; (4) round brilliant, side view; (5) cushion brilliant, top view; (6) rose cut, side view; (7) octagonal step cut; (8) pear brilliant, top view; (9) oblong step cut; (10) high cabochon, side view; (11) cabochon, side view; (12) lentil-shaped, side view.



The Comparative Prices of Gems, based on the weight in carats and quality of the stones, can be seen in the chart of precious gems, left. The widening diamond and emerald lines indicate the spread in price between average and top quality stones. The ruby line indicates the price of top quality stones only, because average quality rubies cost only slightly more than pearls. The value of sapphires increases only gradually with the weight.

Adaptation, courtesy Life 1952 Time, Inc.

the waters of the Persian Gulf and the South Pacific.

Cutting and Polishing

Hardness, transparency, and index of refraction determine the way in which each gem mineral is cut. Cutting of gems is a simple grinding away of the material until the desired shape is reached. Then the stone is polished. A special method is used to cut diamonds, because they are so hard.

The hardness of a stone determines the type of abrasive which must be used on it. For instance, a sapphire or ruby must be cut with carborundum, which is harder than the gem stone. A diamond cannot be worn away by carborundum. It is cut by diamond dust.

The index of refraction must be considered in cutting a stone. A transparent gem that has a high index of refraction is usually cut with facets, or many sides, inclined at the proper angle. The diamond is an example of this. It usually has a "brilliant" cut of 58 facets. The light that strikes the top facets is reflected from some of the facets and enters the stone at others. If the stone is made properly, nearly all the light that enters the stone is then reflected from the back facets.

Rubies have a lower index of refraction than diamonds. They depend on their rich red color for beauty. Rubies are often flawed, and therefore are sometimes cut with a rounded surface. This is called *cabochon* cutting. Flawed emeralds may also be cut *cabochon*.

Value of Gems

Hardness, color, brilliance, rarity, and demand determine the value of gems. Diamonds are generally the most prized gems because they surpass all others in hardness and brilliance. Rubies are more valuable than sapphires because they are more rare, though they have the same degree of hardness. The value of sapphires depends on the quality of their blue color. The emerald is about as valuable a gem as the diamond. Freedom from flaws, the size, and the shades of the green color determine the value of emeralds. Pearls are graded in value by size, color, and perfection of shape. In general, they should be white or lightly tinted, and round. Opals are valued according to their color flashes. The so-called "black" opals are the most valuable. These may actually look black, or may be blue or gray, but emit flashes of many other colors.

Some Famous Gems

Probably the most celebrated diamond in the world is the *Koh-i-noor*, which was presented to Queen Victoria in 1850 by the East India Company. The *Cullinan*

diamond was famous because it was the world's largest. It weighed a little over 1½ pounds originally, but was cut into two large stones, seven smaller ones, and 96 others of lesser size. The largest of these is among the crown jewels of England. It is the 530-carat *Star of Africa*, and is set in the royal scepter. The ruler of England also owns the four most famous spinels (rubies) in the world. One of the most beautiful pearls ever found is *La Pellegrina*. It weighs 111½ grains.

Imitation and Artificial Gems

The beauty of gems has caused an ever-insistent demand for them. But their costliness has made it impossible for many persons to own them. Therefore a great business has existed in imitation gems. The Egyptians made excellent imitations of costly stones by coloring glass. Today, the basis of most imitation gems is a soft glass called *paste*, or *strass*. This glass is very clear and brilliant. It is made of pure powdered rock crystal, red lead, and dry potassium carbonate. Imitation gems made from this paste can be scratched easily. Clear quartz, white sapphires, and colorless zircons make inexpensive substitutes for diamonds. Colored varieties of quartz are substituted for other gems. Citrine, for example, is often sold as topaz. Also sold are assembled stones, or *doublets*, made up of two sections bound by colorless cement, or fused together. Doublets can be made entirely of the stone imitated, only partly of it, or containing no part of the gem being imitated.

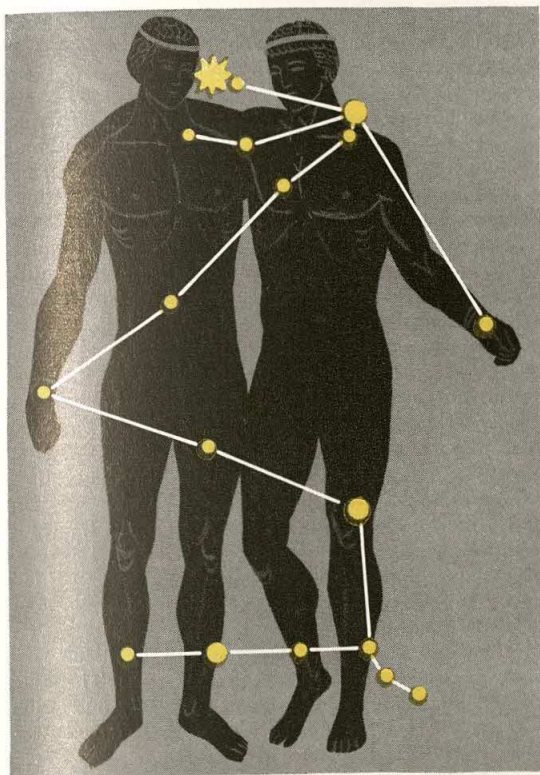
In recent years, synthetic gems of good quality have been produced in the laboratory. Rubies and sapphires have been made by melting aluminum oxide in a flame from oxygen and hydrogen gases. They constitute the bulk of synthetic stones on the market. Other artificially produced gems available include synthetic emerald, spinel, and rutile.

FREDERICK H. POUGH

Related Articles in WORLD BOOK include:

Agate	Coral	Mineral (color pictures, Colorful Minerals)
Alexandrite	Corundum	Moonstone
Amber	Diamond	Onyx
Amethyst	Diopside	Opal
Aquamarine	Emerald	Pearl
Beryl	Garnet	Ruby
Birthstone	Intaglio	Sapphire
Cameo	Jade	Sardonyx
Carat	Jasper	Topaz
Carbuncle	Jet	Tourmaline
Carnelian	Jewelry	Turquoise
Cat's-eye	Lapidary	
Chalcedony	Lapis Lazuli	

GEMARA. See HEBREW LANGUAGE AND LITERATURE; TALMUD.



Gemini, or the Twins, Represents Castor and Pollux.

GEMINI, *JEM ih nye*, or **THE TWINS**, is the third sign of the zodiac and a constellation in the Northern Hemisphere. Because of the precession of the equinoxes, the sign of Gemini is now in the constellation Taurus. The two brightest stars are named for the twins *Castor* and *Pollux*, the children of Leda and Jupiter, in Greek mythology. The symbol of Gemini is ♊ . See also **CASTOR AND POLLUX**; **CONSTELLATION**; **ZODIAC**. I. M. LEVITT
GEMMULE. See **SPONGE** (Life Story).

GEMSBOK, *GEHMZ bahk*, or **GEMSBUCK**, is an antelope related to the sable and roan antelopes. It lives in southwestern Africa, and related species live in southwestern Asia. The gemsbok has long, nearly straight horns that are sharp at the ends. The horns are ribbed at their lower ends and extend backward. The body is reddish-gray on top and white underneath. The head, sides, legs, and back of the body are marked with black.

Scientific Classification. The gemsbok belongs to the family *Bovidae*. It is classified as genus *Oryx*, species *gazella*.
VICTOR H. CAHALANE

See also **ANTELOPE**.

GENDARME, *zhahn DAHRM*, is a French policeman. The title is given to French military police, who perform civil duties much like those of the state police in America, and to members of French city police forces. In wartime, the military police can be called to active duty with the French armed forces. The first gendarmes were the elite armored cavalymen who served as bodyguards to French kings for 450 years before the French Revolution.
THOMAS E. GRIESS

See also **PARIS** (picture, Paris Policemen).

GENDER. In English, living things are classed as male or female, and things without life as neuter, or sexless. In the same way, words are said to belong to the *masculine*, the *feminine*, or the *neuter gender*. *Neuter* and *gender* are derived from Latin words meaning *neither* and *kind*. The word *animal* may represent either a male or female creature. Such words are said to be of *common gender*. These four classifications cover all nouns and pronouns, and explain all the English genders.

English is the only important language in which gender is largely determined by the sex of the object for which the word stands. Some other languages use gender in an entirely different way. A French feminine *hand* (*la main*) opens the feminine *door* (*la porte*) of a feminine *house* (*la maison*). In German, a neuter *girl* (*Mädchen*) gazes at a masculine *moon* (*Mond*) in a feminine *night* (*Nacht*). Several other modern European languages have this same system of gender, and so had Early English, or Anglo-Saxon. Latin, from which many European languages were derived, has a similar use of gender.

Personal Pronouns are the only pronouns that have different forms to show gender. These forms are in the third person singular—*he*, *his*, *him*, *she*, *her*, *hers*, *it*, *its*. The gender of others may be assumed for a particular use if one knows that *I*, *me*, *my*, *mine*, *you* stand for male or female. *It* and *its* are usually neuter, but not always. A young child may be represented by *it* or *its*, as in, "The infant cried for *its* food."

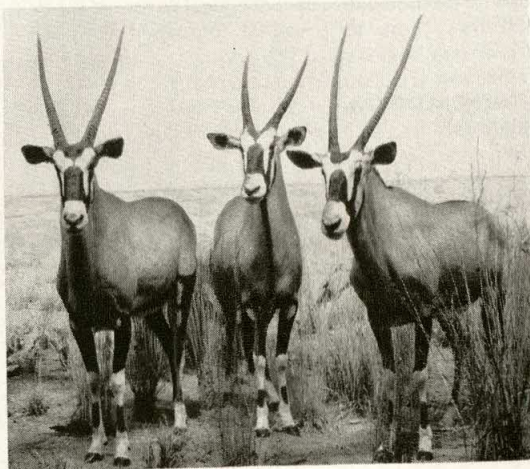
Nouns show the difference between the masculine and feminine gender in three ways.

Some nouns have different forms for the masculine and the feminine. Examples are *man*, *woman*; *boy*, *girl*; *lad*, *lass*; *husband*, *wife*; *cock*, *hen*; *stallion*, *mare*; *gander*, *goose*; *buck*, *doe*; *beau*, *belle*; *wizard*, *witch*.

Many masculine nouns may be made feminine by adding the suffixes *ess*, *ine*, *ina*, *trix*, *ne*, *a* or *ette*. Sometimes a letter in the masculine is changed or omitted when the suffix is added. Examples are *actor*, *actress*; *waiter*, *waitress*; *usher*, *usherette*; *heir*, *heiress*; *duke*, *duchess*; *prior*, *prioress*; *prince*, *princess*; *Paul*, *Pauline*; *Angelo*,

The Gemsbok of Africa has long horns that are almost straight, and an unusual color pattern on its head.

American Museum of Natural History



Angela or *Angelina*; *comedian*, *comédienne*; *administrator*, *administratrix*; *Louis*, *Louisa*; *sultan*, *sultana*. Many such feminine forms are importations from other languages, especially from the French language.

Many words of common gender are made either masculine or feminine by prefixing a word. Examples are *billy-goat*, *nanny-goat*; *he-bear*, *she-bear*.

Nouns of Common Gender are followed by masculine pronouns. "Every member of this group must bring *his* book to the next meeting." Some speakers feel uneasy about using *his* for a group that includes women. But it is incorrect to use *their*, because *every* is singular.

Correct Usage requires the feminine gender when referring to any water craft. "The *Robert Fulton* has discharged *her* cargo." Airplanes are usually also represented by feminine pronouns. Names of countries are sometimes feminine, although this style is being used less and less. "France is rising again to *her* former eminence." Insects and small animals are usually neuter. "My kitten plays with *its* tail."

Writers sometimes personify qualities or things not living and treat them as persons with sex. This is called *personification*. "Famine swept *his* scythe across the land." "Beauty slays us with *her* dart."

Since women have become engaged in many careers, feminine forms such as *authoress*, *editress*, and *poetess* are disappearing from print. The masculine-gender form has become a noun of common gender. CLARENCE STRATTON

GENE, *jeen*, is one of the tiny units that determine what living things inherit from their parents. Genes are located in the *nucleus*, or innermost part of the cell, and are arranged in single file along the threadlike *chromosomes* (see **CELL**; **CHROMOSOME**). There are thousands of genes in every cell, each occupying its regular place on a certain chromosome. Although chromosomes can be seen with a microscope, genes cannot. Scientists determine their locations and properties by indirect methods.

The genes are responsible for all inherited traits. For example, the genes that are inherited from the parents determine whether a child will have blue or brown eyes and whether it will be a boy or a girl.

Genes produce their effect by influencing chemical processes during the growth of the individual. Scientists do not know the exact chemical nature of the gene, but they think the essential ingredient is *deoxyribonucleic acid*, abbreviated DNA. JAMES F. CROW

See also **GENETICS**; **HEREDITY**; **MUTATION**.

GENEALOGY, *JEN ee AL oh jih*, is the study of family relationships and the pattern they follow back through the years. Careful genealogical research may enable a person to trace his descent from some of his earlier ancestors, and to draw an accurate family tree.

Persons undertake the study of genealogy for various reasons. Sometimes their reasons are largely sentimental or based on curiosity concerning the past or historical fact. The legal right to inheritance of property may develop from genealogical study, as may the right to membership in various patriotic societies. A desire to show descent from nobility or royalty prompts some persons to investigate their family trees. Genealogical study may result in valuable or interesting information about early manners, customs, and social conditions. In some

countries, such as China and Japan, the study of genealogy is important to religion, because the people of those countries revere their ancestors.

Genealogical research must start at home and must progress from recent ancestors to earlier ones. Old family records, letters, and documents often establish family relationships back through one or two generations, and sometimes farther. Additional information is sometimes obtained from relatives and their family records.

The next step in genealogical study usually involves an investigation of the records of cities and counties where ancestors are known to have lived. Government records, such as land grants, sometimes help. Church records and records of births, marriages, and deaths furnish valuable information. Another valuable source of information in the United States is the 1790 census.

Genealogical research is aided by printed pedigrees of families, and by town and county histories. Material of this type may be found in public libraries or in libraries such as the Library of Congress in Washington, D.C., the Newberry Library in Chicago, the Henry E. Huntington Library in San Marino, Calif., and the New England Historical and Genealogical Society Library in Boston. The services of genealogists are available at a fee as an aid in tracing family lines.

The Biblical books of Genesis and Leviticus have some examples of early genealogical trees. These accounts indicate the importance of family and tribal records among early peoples. JOSEPH CHARLES WOLF

See also **BURKE'S PEERAGE**.

GENERAL. See **RANK IN ARMED SERVICES**.

GENERAL ACCOUNTING OFFICE is an independent agency in the legislative branch of the United States government. It is often called "the strong right arm of Congress." This office audits, or examines, the book-keeping of all branches of the government. It is one of the world's largest accounting and auditing organizations. It provides Congress with annual reports.

The General Accounting Office investigates to see if various agencies are using public money efficiently. It assists Congress and Congressional committees in all matters relating to public funds. It collects for the government each year millions of dollars that have been spent improperly or illegally. It also settles claims by or against the United States.

The office was established in June, 1921. Its six auditors are under the direction of the Comptroller General of the United States. JOHN C. BOLLENS

See also **COMPTROLLER GENERAL OF THE UNITED STATES**.

GENERAL AGREEMENT ON TARIFFS AND TRADE (GATT). See **TARIFF** (The Politics of the Tariff).

GENERAL ASSEMBLY. See **UNITED NATIONS; ASSEMBLY**.

GENERAL BEADLE STATE TEACHERS COLLEGE is a state-controlled coeducational college in Madison, S. Dak. Courses lead to bachelor's degrees. It has a summer session and an extension division. The school was founded in 1881, and took its present name in 1947. It has an average enrollment of about 400 students.

GENERAL DELIVERY. See **POST OFFICE**.

GENERAL EDUCATION BOARD was a foundation that aided education in the southern United States. It received most of its original \$130,000,000 fund from John D. Rockefeller. It functioned from 1902 to 1953.

GENERAL ELECTRIC COMPANY is the largest electrical-equipment concern in the world. It designs, manufactures, and sells almost every kind of device connected with the use of electricity. The firm was formed in 1892 by a combination of the Thomson-Houston Electric Company and the successor of the Edison Electric Light Company, which was founded by Thomas A. Edison.

Corporate headquarters of General Electric are in Schenectady, N.Y. The company has about 160 main manufacturing plants. For sales, assets, and number of employees, see MANUFACTURING (table, 100 Leading Manufacturers).

In Canada, General Electric products are made and sold by the Canadian General Electric Company, Limited. This company has its main offices in Toronto, Ontario, and branch offices in nearly every large city in Canada.

General Electric products are sold in other parts of the world by the International General Electric Company. This company has offices in Australia, Cuba, Great Britain, India, Indonesia, Mexico, the Philippines, Portugal, Puerto Rico, South Africa, Spain, Turkey, and various countries in South America.

The company has more than 40 research laboratories. It also owns and operates several radio stations. The General Electric Company also maintains the television station WRGB and the FM station WGFM in Schenectady.

ROBERT D. PATTON

GENERAL FEDERATION OF WOMEN'S CLUBS. See WOMEN'S CLUBS, GENERAL FEDERATION OF.

GENERAL FOODS CORPORATION. See FOOD (table, 25 Largest Food-Processing Companies).

GENERAL GRANT NATIONAL PARK. See KINGS CANYON NATIONAL PARK.

GENERAL MOTORS CORPORATION is one of the largest manufacturing concerns, and the largest producer of automobiles, in the world. The corporation was formed in Delaware in 1916 to take the place of the General Motors Company of New Jersey. The General Motors Corporation has about 100 manufacturing plants in the United States, and has sales offices in most important cities. It operates branch plants in Australia, Canada, Germany, Great Britain, and other countries. For assets and number of employees, see MANUFACTURING (table, 100 Leading Manufacturers).

Passenger automobiles, trucks, cabs, and buses are manufactured by General Motors plants. Its trade names include those of Buick, Cadillac, Oldsmobile, Pontiac, and Chevrolet. Automobile parts made by the corporation include bodies, spark plugs, oil filters, air cleaners, speedometers, hydraulic shock absorbers, ignition and starting systems, batteries, ball bearings, heaters and radiators, steering wheels, and roller bearings.

Products made by General Motors outside the automobile field include oil burners and furnaces, refrigerators, freezers, air-conditioning equipment, diesel locomotives, power plants for trains, and airplane, gasoline, and diesel engines.

General Motors research and experimental centers are situated in Detroit and Milford, Mich., and Phoenix, Ariz. In 1956, General Motors opened a giant technical center at Warren, Mich. It ranks as one of the world's greatest research institutions.

GENERAL STAFF

In 1948, General Motors pioneered in labor relations with a contract tying wages to the cost of living and providing annual increases to correspond with increased productivity. Other companies have since made similar agreements.

FRANKLIN M. RECK and MARY R. ZIMMER

See also CURTICE, HARLOW H.; DURANT, WILLIAM C.; KETTERING, CHARLES F.; KNUDSEN, WILLIAM S.; WILSON, CHARLES ERWIN.

GENERAL SEMANTICS. See SEMANTICS.

GENERAL SERVICES ADMINISTRATION (GSA) is an independent agency of the United States government. It was set up in 1949 as a central organization for such housekeeping activities as supply, records management, and public buildings operations. It determines the supply needs of many federal agencies and buys personal property for them. It sets up standards and tests, and inspects purchases. It promotes the use and disposal of excess government-owned personal property. The GSA maintains centers for the distribution of supplies, equipment, and materials to government offices.

The administration helps agencies develop programs for retaining frequently used records, and for storing or disposing of unused records. The National Archives, a part of the GSA, receives materials of historical importance. The Federal Register Division, also part of the agency, publishes the *Federal Register*. This publication records actions of the President and federal agencies that affect private individuals. It also gives considerable information on governmental organizations and their practices.

Buildings leased or owned by the government also come under the supervision of the GSA. It assigns space in buildings controlled by the government. It disposes of real property not needed by federal agencies. It also has the responsibility of obtaining a stockpile of strategic materials essential in emergencies.

JOHN C. BOLLINS

GENERAL SHERMAN TREE, largest of the giant sequoias, stands in Sequoia National Park, California. The tree is approximately 272 feet high, with a circumference of 101.6 feet. It is about 3,500 years old, and is one of the oldest living things. James Wolverton discovered the tree on Aug. 7, 1879, and named it for General William T. Sherman.

JAMES J. CULLINANE

See also SEQUOIA; SEQUOIA NATIONAL PARK.

GENERAL STAFF is a group of officers who advise the officer in command of any large military headquarters. The United States Secretary of the Army is assisted by the Army General Staff. Officers selected from the Regular Army, the National Guard, and the Army Reserves make up this staff.

The Army General Staff includes the Chief of Staff, the Vice Chief of Staff, and a secretary, as well as the Comptroller of the Army and Deputy Chiefs of Staff for Military Operations, for Personnel, and for Logistics. The Assistant Chiefs of Staff for Intelligence and for Reserve Components also belong to the group. It has a Committee on National Guard and Army Reserve Policy.

General staffs supervise army areas and major command elements. The headquarters of various army divisions have general-staff groups commonly called the General Staff.

ELBRIDGE COLBY

GENERALIZATION

GENERALIZATION, *JEHN ur ul ih ZAY shun*, is an intelligent guess based on a number of known cases. When a doctor tells a patient with pneumonia that sulfa will probably help him because sulfa has helped most pneumonia patients, the doctor is generalizing.

We use the experience of others as well as our own to test generalizations. A child in the United States could quite logically generalize that all cats have tails, on the basis of his own experience. He may learn from reading that this generalization is false, because Manx cats have no tails.

A generalization based on too few examples is called a *hasty generalization*. For example, a person who has been bitten by a dog may say that all dogs bite. To generalize on the basis of a few cases is often a dangerous practice.

A *biased generalization* is based on a special class of cases. If we discover that most workers in the automobile industry have cars, we cannot infer that workers in the textile industry will also have cars.

A *representative sample* consists of a set of cases which fairly represents all the known cases. A generalization based on a representative sample is more likely to be reliable. To select a representative sample, we need to be sure that we have not selected a biased sample based on special cases. In the sample, all the members must be distributed in the same proportion as in the general population, and all varieties that occur in the general population must be represented.

LOUIS O. KATTSOFF

See also **INDUCTIVE METHOD**; **LOGIC**; **STATISTICS**.

GENERATION is a term used to mean any stage necessary to continue the survival of a species. This means that one rank in natural descent must be followed by another. For example, parents represent one generation, children, the next. Each generation of man is considered to be about 25 years. Generation may also mean one stage in the life cycle of an individual, if the stages are markedly different. See also **ALTERNATION OF GENERATIONS**; **PLANT** (How Plants Reproduce); **REPRODUCTION**.

CLAIR L. WORLEY

GENERATOR. See **ELECTRIC GENERATOR**.

GENESEE RIVER, *JEN uh see*, starts in northern Pennsylvania and follows a northward course for 144 miles through New York. It empties into Lake Ontario seven miles north of Rochester. For location, see **NEW YORK** (color map). The boats that travel along the New York State Barge Canal cross the river at Rochester. Just before it reaches the broad Lake Ontario plain at Mount Morris, N.Y., the Genesee rushes through a deep gorge. The area in which this gorge lies is included in Letchworth Park, a New York state park. The Indian word *Genesee* means *beautiful valley*.

WILLIAM E. YOUNG

GENESIS, *JEN uh sis*, is the first book of the Bible. Its name comes from a Greek word meaning *birth* or *beginning*. The first part of Genesis describes God's creation of the world, and relates the stories of Adam and Eve in the Garden of Eden and of Cain and Abel. It then tells of the *Deluge*, or great flood, from which only Noah and his family escaped (see **DELUGE**).

Most of the book (chapters 12 to 36) describes the lives of the three *patriarchs*, or fathers, of the Jewish people—Abraham, Isaac, and Jacob (see **PATRIARCH**). The last section (chapters 37 to 50) tells the story of

Joseph, Jacob's son, who was sold into slavery by his brothers and later rose to become a government official in Egypt.

People admire the book of Genesis for its religious and ethical ideas and its great literary quality. The Russian novelist Leo Tolstoy called the Joseph story, "the most perfect narrative ever written." ROBERT GORDIS

There is a biography in **WORLD BOOK** for each person mentioned in this article. See also **PENTATEUCH**.

GENÊT, *zhuh NEH*, **EDMOND CHARLES ÉDOUARD** (1763-1834), created the first international crisis for the United States. He was sent to the United States as minister from France in 1792, during the French Revolution. Americans called him "Citizen Genêt," and welcomed him as the representative of a people fighting for liberty. France was very popular in America at that time because it had aided the colonists during the Revolutionary War in America.



Albany Inst. of Hist. and Art

Edmond Genêt

But Genêt quickly stirred up trouble. His mission was to persuade the United States, as an ally of France, to declare war against Great Britain. He also wanted to raise an army in America to help get Louisiana back from Spain. President George Washington had declared the United States neutral in the European quarrels, but Genêt proceeded to arm ships and raise recruits in American ports. These acts were a violation of American neutrality. His actions forced Washington in 1794 to ask France to recall him.

Genêt was ordered to return to France for trial, but Washington saved him from having to return. He settled in New York and became a United States citizen. He first married the daughter of Governor Governor Clinton of New York, and later the daughter of Postmaster General Samuel Osgood (1748-1813).

ANDRÉ MAUROIS

GENETIC DRIFT. See **WRIGHT**, **SEWALL**.

GENETICS, *juh NET icks*, is the science of inheritance. It deals with the ways in which living things are like their parents, and the ways in which they are different. The study of genetics provides the scientific basis for animal and plant breeding.

Gregor Johann Mendel, an Austrian monk, discovered the rules of inheritance in the 1860's. Mendel performed controlled experiments on garden peas. He found that inherited characters are carried by tiny particles, now called *genes*. But scientists did not appreciate the importance of Mendel's work until 1900. In the 1910's, Thomas Hunt Morgan and his students at Columbia University studied the fruit fly, *Drosophila melanogaster*. They found that genes are arranged in single file along the *chromosomes*, the threadlike bodies in the nuclei of cells. Chromosomes can be seen through a microscope, but genes cannot. Geneticists have located several hundred genes at specific places on fruit-fly chromosomes. These genes affect eye color, wing shape, number of hairs, and other traits. Each animal or plant receives half its genes from the father and half from the mother.

The most important applications of genetics have been in agriculture. By using breeding methods based on known genetic principles, plant breeders have produced improved strains that have high yields and are resistant to diseases. The seedless watermelon is an example of an improved variety produced through the use of genetic knowledge. High-yielding hybrid corn ranks as one of the most important accomplishments of genetics (see CORN [Hybrid Corn]). Genetics is also important in medicine, because many diseases are inherited.

Geneticists have found that the rules of heredity discovered by Mendel apply to the simplest forms of life, the bacteria and viruses. Because these organisms are so simple, scientists find them easy to use in experiments. Many advances in genetics have come from experiments on these organisms.

JAMES F. CROW

Related Articles in WORLD BOOK include:

Breeding	Gene	Mendel, Gregor Johann
Chromosome	Heredity	Morgan, Thomas H.
Eugenics	Inbreeding	

GENEVA, or **GENÈVE** (pop. 155,300; met. area, 178,900), is the capital of the Geneva Canton in Switzerland. The city lies at the western end of Lake Geneva, at the outlet of the Rhône River. The river divides Geneva into two sections. Bridges link the two sections of the city. For location, see SWITZERLAND (color map).

Geneva is one of the world's most famous international cities. Switzerland's neutrality prevents the country from participating in political and military alliances, but provides an impartial meeting-ground for other countries. Many world organizations have headquarters in Geneva. The United Nations has its European headquarters and several service divisions in the city. These divisions include the Economic Commission of Europe, the European Organization for Nuclear

Research, and the Commissions on Narcotic Drugs, Traffic in Opium, and Human Rights.

The city also serves as headquarters of the International Red Cross, the International Labor Organization, the International Refugee Organization, and the World Health Organization. The League of Nations had its headquarters in Geneva until 1946. The League's Palace of Nations still stands, and is used for offices, committees, and congresses. France, Great Britain, Russia, and the United States held a Big Four Conference in Geneva in 1955.

Geneva also serves as a theological and cultural center. It was the home of John Calvin (after 1536). Calvin founded the Collège de Genève in 1559. Scholars from many countries study at the University of Geneva. The city's buildings include the Romanesque Cathedral of Saint Peter, the Town Hall, and museums of antiquity, fine arts, and natural history. One of its most famous landmarks is a monument to the Reformation.

The city has long been a producer of fine jewelry, clocks, and watches. The Swiss watchmaking industry began in Geneva in the 1500's. Geneva also produces a wide range of aromatic substances and scent bases used in the perfume and soap industries.

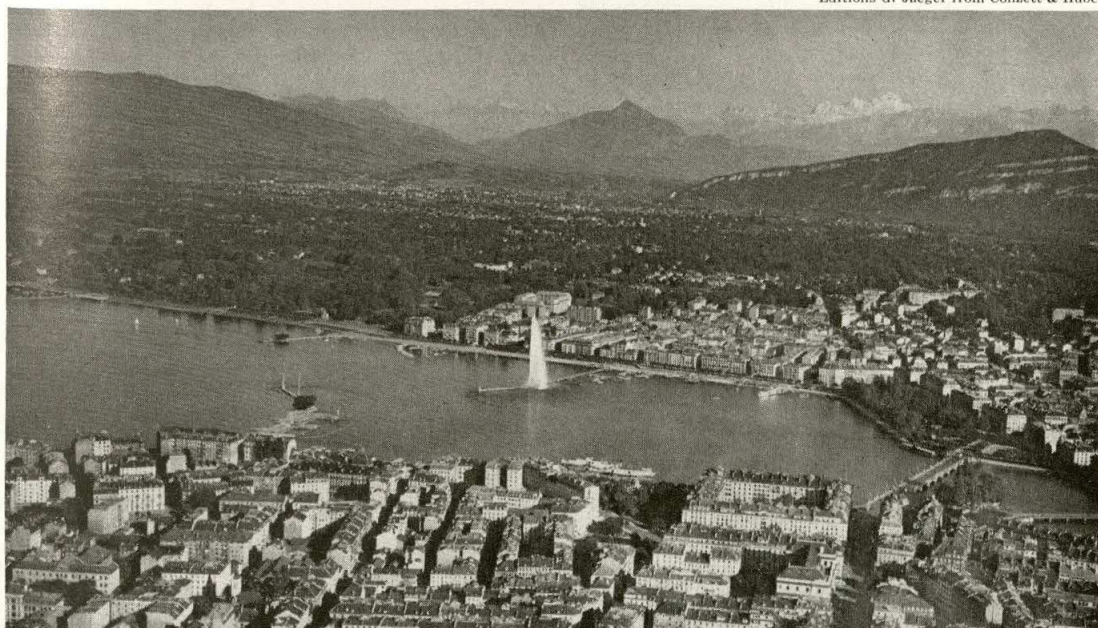
Geneva was part of the Roman Empire until about A.D. 440, when the Burgundians gained control. It was incorporated into the Holy Roman Empire in the 1000's. In the 1500's, Geneva gained fame as the seat of the Reformation under John Calvin, which helped establish Protestantism in Europe. The city came under control of the French during the Napoleonic Wars, and became part of the Swiss Confederacy after the Congress of Vienna in 1815.

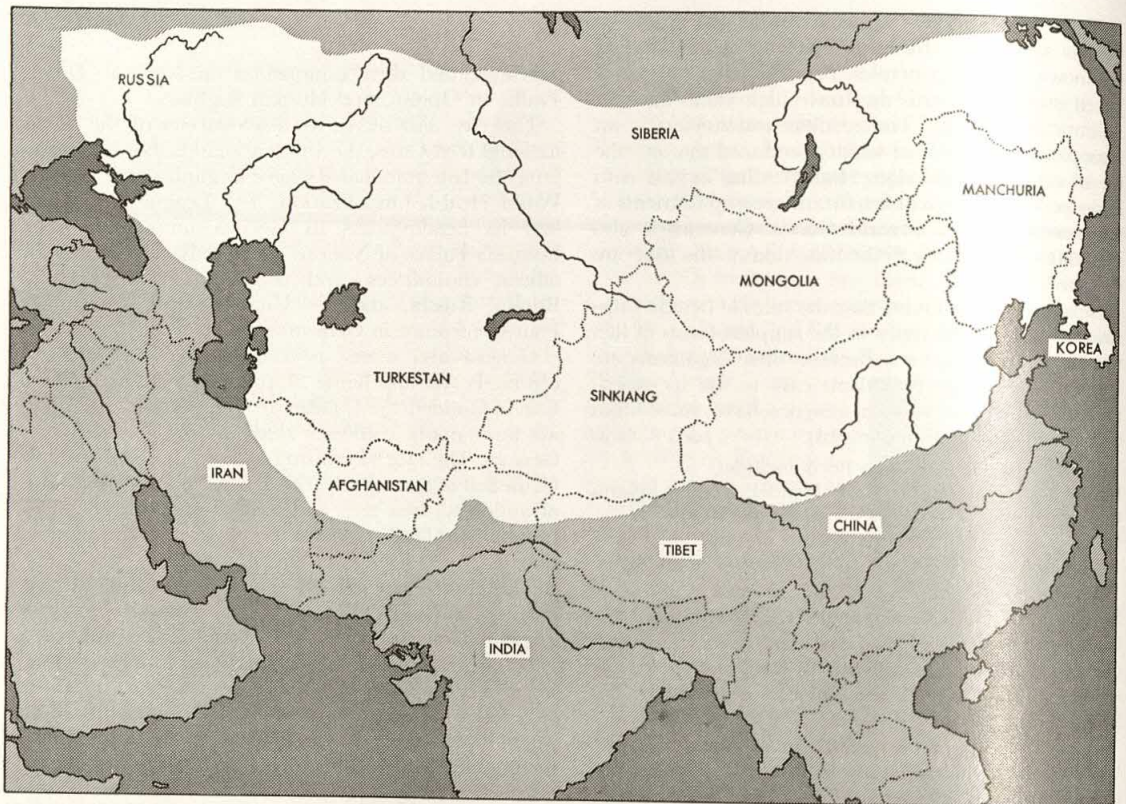
See also CALVIN, JOHN.

FRANKLIN C. ERICKSON

The Towering Stream of Water from Geneva's Famous Fountain Jet d'Eau, Center, Can Be Seen for Miles.

Editions G. Jaeger from Conzett & Huber





Lands Conquered by Genghis Khan (Shown in White) Marked Him as One of History's Greatest Military Leaders.

GENEVA, LAKE. See LAKE GENEVA.

GENEVA ARBITRATION. See ALABAMA (ship); WASHINGTON, TREATY OF.

GENEVA COLLEGE is a coeducational liberal arts college at Beaver Falls, Pa. Degrees in education, music, business administration, and industrial engineering are also offered. Geneva is the only college controlled by the Reformed Presbyterian Church. It was founded in 1848 by John Black Johnston. For enrollment, see UNIVERSITIES AND COLLEGES (table).

GENEVA CONVENTIONS provide for the humane treatment of prisoners and wounded men in wartime. The first Geneva Convention, or Treaty, was signed in 1864. Its terms were accepted by all European countries, by the United States, and by some of the countries of Asia and South America. Agreements in 1906, 1929, and 1949 added new provisions.

The Geneva Conventions include such provisions as the treatment and care of wounded and sick servicemen in the field, wounded, sick, and shipwrecked members of the armed forces at sea; the treatment of prisoners of war; and the protection of civilian populations in time of war, such groups as members of militias and volunteer corps. Methods are provided to identify the dead and wounded, and to send information to their families. The protection of hospitals and medical transports, their proper marking with a red cross, and numerous other provisions and laws for the conduct of parties at war are also set forth in the Geneva conventions.

DWIGHT E. LEE

See also PRISONER OF WAR; RED CROSS.

GENGHIS, or JENGHIS, KHAN (1167-1227), started as the chief of a small Mongol tribe, and became the founder of a vast empire and one of the greatest conquerors in history. Before his death, he claimed wide territories in the East, including China. He invaded what is now Iran, northwest India, and part of Russia.

Genghis Khan and his armies swept across northern Asia in the early 1200's and invaded Bulgaria in southeast Europe in 1223.

Historical Pictures Service



His real name was *Temujin*, meaning *iron smith*. When he was 13 years old, he succeeded his father as chief and began to extend his power over neighboring tribes. He was proclaimed *Great Khan* after he defeated two of the many politically influential Mongolian clan-confederacies of his time. In 1206, he took the title of Genghis Khan. He united all Mongolian tribes and established his empire in the area of the steppes (central Asian plains), where he organized the wandering inhabitants into a rigid military system. He also incorporated into this system non-Mongol Altaic peoples like the Kirghiz (see *KIRGHIZ*). For these steppe people, Genghis Khan established the *Yassa*, the first Mongolian code of laws.

Other Conquests. After he had accomplished this organization, Genghis Khan planned the conquest of the entire world. He claimed that he was commanded by the "eternal blue sky," the highest supernatural power the old Mongolian religion recognized.

Between 1205 and 1209, Genghis Khan conquered the Hsi Hsia empire, now the Chinese province of Kansu and the Ordos region. Between 1211 and 1215, he attacked the Chin empire in North China. He conquered Peking in 1215. In 1218, Genghis Khan's forces crushed the empire of the Kara Kitai.

This conquest brought Mongolian power to the frontier of the Moslem state of Khorezm, which Genghis Khan attacked and destroyed. In 1220 and 1221, Genghis Khan took and totally destroyed Bukhara, Samarkand, and Gurgan, then the centers of Moslem-Persian culture. He then sent his generals with two smaller armies to south Russia, where they defeated the Kumans empire. They also defeated the army of a Russian princess in 1223.

After his death, Genghis Khan was buried in the Burkhan Khaldun Mountains. The actual site of the grave is unknown, although a tomb in the Urdus region of Inner Mongolia is worshiped. Each of Genghis Khan's four sons received a part of the Mongolian Empire under the condition that they would recognize the authority of the Great Khan. His grandson was the Kublai Khan of Marco Polo's *Travels* (see *KUBLAI KHAN*).

FRANZ MICHAEL

See also *MONGOL EMPIRE* (Early Empire).

GENII, *JEE nih eye*, were protective gods worshiped by the ancient Romans. The Romans believed that every person had one *genie* who protected and guided him. The word *genie* is often used in English for *jinni*, the Arabic name for a kind of demon. These *jinn*, or *genii*, were important in the Islamic religion. The *Arabian Nights* contains many stories about them.

Moslems believed that the jinn were intelligent airy or fiery bodies. They were invisible, but could appear under various forms, both human and animal. They were capable of carrying out heavy labors. According to Arabian mythology, the jinn were created out of smokeless flame, and mankind and the angels were created of clay and light. There were both good and bad jinn. In the *Arabian Nights* and in fables of the Near East, the good jinn helped mankind. A good jinni helped Aladdin when he rubbed his magic lamp. The evil jinn enjoyed playing tricks on people.

I. J. GELB

See also *ARABIAN NIGHTS*.

GÉNISSAT, ZHAY NEE SYAH, DAM stands on the Rhône River at the foot of the Jura Mountains in France. It is 345 feet high and has a volume of 875,000 cubic yards. The dam and the hydroelectric plant there were completed in 1949. See also *DAM*.

GENITIVE CASE. See *CASE*.

GENIUS, in psychology, is a person with an I.Q. of 140 or over. See *INTELLIGENCE QUOTIENT*.

GENNESARET. See *SEA OF GALILEE*.

GENOA, JEN oh uh, or GENOVA (pop. 727,000), was the birthplace of Christopher Columbus. It is the largest port in Italy, and the country's fifth largest city. Genoa lies in northern Italy, at the southern end of a passageway that divides the Apennine Mountains from the Alps. For location, see *ITALY* (color map).

Genoa, on the gulf that bears its name, provides the chief outlet to the western Mediterranean Sea for the products of the rich Po Valley and the industrial centers of Milan and Turin. It ranks second in size only to Marseille among Mediterranean ports. Genoa has a natural harbor, but heavy traffic has made it necessary to enlarge the port by the building of jetties (see

Griff Davis, Black Star

Genoa's Most Famous Son, Christopher Columbus, was born in the carefully preserved brick building, right. The fortified towers were built in 1155 as part of a great wall that was used to defend the city.



GENOA, GULF OF

JETTY). Chief imports include coal, oil, iron ore, cottons, and cereals for the northern industrial cities. Exports include silk and cotton goods, olive oil, wine, and other products. Industries include shipbuilding, iron and steel refining, food canning, and tanning. Genoa produces about a fourth of Italy's soap.

The city has many splendid palaces, including the municipal palace built in 1564. Among its famous churches are the cathedral of San Lorenzo, consecrated in 1118, and the medieval church of San Donato. Genoa has fine schools. The University of Genoa was founded in 1623. The city also has several philanthropic institutions, a notable library, and an Academy of Fine Arts. San Carlo Theater is one of the largest in Italy. The famed monument of Columbus, sculptured by Michele Canzio, stands in Piazza Acquaverde.

Genoa was a famous seaport under Roman rule in the 200's B.C. After the breakup of the empire of Charlemagne in A.D. 843, Genoa became a republic, presided over by doges (see DOGE). From 1119 to 1284, Genoa warred with Pisa and was finally victorious. The 1200's marked the beginning of a series of wars with Venice for control of commerce in the East. Meanwhile, civil strife in the republic led to government reforms. Peace was restored in 1528 and lasted through the 1700's. The government became a strict aristocracy. Little by little, Genoa lost all its foreign possessions. Corsica, the last of these, was ceded to France in 1768. The French took Genoa in 1800, after the Battle of Marengo, and annexed the city to the French empire in 1805. In 1815, Genoa fell under the rule of the kingdom of Sardinia, which became part of united Italy in 1861.

British planes and ships bombed and shelled Genoa during World War II. In the late 1950's, the Genoese built an airfield that extends over the sea, because the city lies on hill and mountain slopes. Until that time, Genoa was the only large European city without an airport.

BENJAMIN WEBB WHEELER

GENOA, GULF OF. See GULF OF GENOA.

GENOA CONFERENCE was a meeting of representatives of European nations at Genoa, Italy, in April and May, 1922. It was promoted by David Lloyd George, Prime Minister of Great Britain, who hoped it would lead to economic stability and a war-debt settlement.

The main subjects discussed at the conference were German reparations and the debts of the Soviet Union. The Russians refused to pay the debts owed by the Czarist government until assured of credits and recognition as a nation by the other powers. In the midst of the conference, Germany and the Soviet Union announced that they had signed a treaty at Rapallo. By the terms of this treaty, the two nations cancelled their debts to each other and resumed diplomatic relations. The conference broke up without reaching an agreement.

DWIGHT E. LEE

GENOCIDE, *JEN oh side*, is the mistreatment or extermination of national or religious groups. Genocide is committed by organized groups, usually governments, rather than by individuals. The word *genocide* comes from the Greek word *genos*, which means *race* or *tribe*, and the Latin *-cide*, meaning *killing*.

Throughout history there have been persecutions and atrocities which can be described as cases of genocide.

The Russian *pogroms*, or persecutions of the Jews, during the late 1800's, and the Turkish persecutions of Armenians during World War I, are examples of genocide. During World War II, the Germans killed nearly six million European Jews.

The United Nations drew up an international convention in 1948 which made genocide a crime. The United States has not ratified the Genocide Convention. Some persons oppose subjecting citizens of the United States to any international criminal law. Others believe that the convention will promote the development of international law to prevent atrocities.

TELFORD TAYLOR

See also NUREMBERG TRIALS; WAR CRIME.

GENRE, *ZHAHN' r*, **PAINTING** is a kind of painting that shows subjects from daily life. Many genre pictures tell a story. Flemish masters of the 1500's excelled in genre. See also PAINTING (Everyday Life).

GENSERIC, *GEHN suh rick*, or **GAISERIC** (395-477), was a powerful king of the Vandals (see VANDAL). He conquered all Africa west of Carthage in A.D. 429. Finally he seized Carthage and made it the capital of his possessions. He also placed a powerful fleet of ships in the harbor. Then he captured parts of Sicily, Sardinia, and Corsica. In 455, he plundered Rome at the suggestion of Eudoxia, the widow of Valentinian III (see VALENTINIAN). Eudoxia was eager for revenge against Maximus, who had murdered her husband to become emperor. After two weeks in Rome, Genseric left the city with his soldiers, carrying off Eudoxia and her two daughters.

ROBERT GEHLMANN BONE

GENT. See GHENT.

GENTIAN, *JEN shun*, is a group of beautiful wild and cultivated plants that includes about 600 species. The flowers are often blue, but may be yellow, white, or red. Gentians grow throughout the world except in Africa. About 20 species thrive in the United States. The *fringed gentian* is the best-known species in North America. Its bright blue, open, bell-shaped flowers appear early in fall. Each stem bears a single flower. The plants grow from 1 to 3 feet tall and have long, pointed leaves. It is this flower that inspired William Cullen Bryant's poem, "To the Fringed Gentian."

The flowers of many gentians never open. These are called *closed*, or *bottle*, gentians. The common closed gentian of the eastern United States has clusters of blue flowers from August to October.

A large yellow gentian grows in the Alps and Pyrenees mountains at elevations of from 3,000 to 6,000 feet. The plants are about six feet tall and bear clusters of open yellow flowers. The yellowish-brown bitter root of these gentians is used as bitters and as a medicine.

Scientific Classification. Gentians belong to the gentian family, *Gentianaceae*. The fringed gentian is genus *Gentiana*, species *crinita*; the closed gentian is *G. andrewsii*; and the yellow gentian is *G. lutea*.

ROBERT W. HOSHAW

GENTILE, *JEN tile*, in ancient times, referred to the people of all nations other than the Jews. Throughout the Bible, the term *Gentile* designates any non-Jews. Today, the word is sometimes used to mean *Christian*. In the historical sense, however, this is not a correct use. The earliest Christians were Jews, and not until Saint Paul began his zealous missionary work did Gentiles begin to come into the Christian church in large numbers. Both Mormons and Moslems consider all persons not of their faith to be Gentiles.

WILLIAM F. ROSENBLUM

GENTLEMAN BOSS. See ARTHUR, CHESTER ALAN.

GENTLEMAN'S AGREEMENT. In the 1890's, many persons feared that workers coming to the United States from Japan would take all the jobs and put them out of work. They wanted Congress to pass a law preventing further immigration. Japan protested, and made the *gentleman's agreement* of 1907 instead. Japan promised to halt unrestricted emigration to the United States. In return, President Theodore Roosevelt promised to discourage any law limiting Japanese immigration. Since then, the term has been applied to any measure agreed upon by a class or group of people, but not made into law, that affects the welfare of another group. See also ORIENTAL EXCLUSION ACTS.

ROBERT RIENOW

GENUS, JEE nus, is a group of closely related animals or plants. It consists of a number of species of animals or plants which differ from one another in only slight characteristics. All species of roses, for example, are grouped in the genus *Rosa*. A group of genera forms a family. See also CLASSIFICATION.

WILLIAM C. BEAVER

GEOCHEMISTRY is the science that investigates problems such as how the chemical elements are distributed throughout the earth, and how they came to be there. Geochemists also study how the elements move through minerals, rocks, soil, water, and air.

Geochemists base their classification of the elements on the theory that the earth was formed from a cooling mass of hot gases (see EARTH [How the Earth Began]). Several liquid layers formed as the mass cooled. The central layer of molten metal contained the *siderophil elements* (iron, nickel, cobalt, and others). The *lithophil elements* (aluminum, silicon, and magnesium) were concentrated in molten silicates. The *chalcophil elements* (sulfur and zinc) were concentrated in molten iron sulfide, the *atmosphill elements* (oxygen, nitrogen, and carbon) in the atmosphere, and the *biophil elements* (carbon, nitrogen, oxygen, and phosphorus) in living matter. The study of isotopes has helped geochemists determine the age of the earth and the history of meteors (see ISOTOPE).

Geochemistry developed mainly in the 1900's, although it was named in 1838 by the Swiss chemist, Christian F. Schoenbein. Schoenbein discovered ozone, a form of oxygen (see OZONE). The greatest figure in the history of geochemistry was V. M. Goldschmidt of Norway. He applied X-ray analysis of crystal structures to explain geochemical problems in terms of the sizes and electrical charges of the atoms.

WALTER J. MOORE

See ELEMENT, CHEMICAL; MINERAL; PROSPECTING.

GEOCHRONOLOGY. See ARCHAEOLOGY (Absolute Chronology).

GEODE, JEE ode, is a hollow, stonelike formation often lined with crystals. Geodes are found in many parts of the world. They usually average from 2 to 6 inches in diameter. One type, found in Uruguay, is called *hydrolite*, or *water stone*. It contains quartz crystals left when water that had silica in solution evaporated.

GEODESY, jee AHD ee sih, is the science that deals with the shape, size, and curvature of the earth. The word *geodesy* means *earth-measurement*. Geodesy is the branch of surveying that tells how to measure great distances and locate points on the earth's surface. Whenever a survey extends over a large area, a method known as *triangulation* is used. This is based on the principle in trigonometry that if at least one side and two angles of a triangle are known, the other two sides and the third

GEOGRAPHS

angle can be computed. See also COAST AND GEODETIC SURVEY; SURVEYING; THEODOLITE.

HERMAN J. SHEA

GEODETIC CENTER OF NORTH AMERICA is located at the Meades Ranch Triangulation Station in Osborne County, Kansas. It serves as the point of origin for all governmental mapping in the United States (except Hawaii), Canada, and Mexico. The U.S. Coast and Geodetic Survey arbitrarily chose Meades Ranch as the geodetic center of the United States in 1901. This point was just one of many established in surveying the United States, and was chosen because of its central location. Meades Ranch became the geodetic center of North America in 1913, after Canada and Mexico adopted it as the data point for their surveys.

GEODETIC SURVEY. See COAST AND GEODETIC SURVEY.

GEODUCK. See GOEDUCK.

GEOFFREY, COUNT OF ANJOU. See PLANTAGENET.

GEOFFREY OF MONMOUTH (1100?-1154?) was a Welsh historian. Most of the legends of King Arthur and the Knights of the Round Table, and many other stories, came from Geoffrey's *Historia Regum Britanniae* (History of the Kings of Britain). See ROUND TABLE.

His work is said to be chiefly translations of ancient Breton manuscripts, and is mainly a mythical history of British kings from the days of the legendary hero Brutus, the Trojan, to A.D. 688. Geoffrey was born in Monmouth. He may have been a monk. FRANCIS J. BOWMAN

GEOGRAPHIC CENTER OF NORTH AMERICA is near the center of Pierce County, North Dakota, just southwest of Rugby. A stone cairn marks the exact spot. The U.S. Geological Survey defines the geographic center of an area as "that point on which the surface of the area would balance if it were a plane of uniform thickness." For location, see NORTH DAKOTA (color map).

GEOGRAPHIC CENTER OF THE UNITED STATES is located in South Dakota. It lies about 17 miles west of Castle Rock in Butte County. Before Alaska became a state in 1959, the geographic center was located in Smith County, Kansas. With the admission of Alaska in January, 1959, it moved to Butte County, South Dakota. When Hawaii became a state later in 1959, the geographic center shifted 6 miles west-southwest. For location, see SOUTH DAKOTA (color map).

GEOGRAPHIC NAMES, BOARD ON, a federal agency of the United States, decides on standard names for geographic places throughout the world. These names become standard for all federal publications. Members of the board come from each executive department of the government and from several other agencies. The Secretary of the Interior approves all decisions. Congress created the board in 1947. JOHN C. BOLLENS

GEOGRAPHIC SOCIETY, NATIONAL. See NATIONAL GEOGRAPHIC SOCIETY.

GEOGRAPHIC SOCIETY, ROYAL. See ROYAL GEOGRAPHIC SOCIETY.

GEOGRAPHS, jee AHG ruh fohs, is an *asteroid*, or young planet, that was discovered on Aug. 31, 1951, by astronomers at Mount Wilson and Palomar observatories in California. It is one of several asteroids whose orbits swing inside that of Earth. Its orbital plane is inclined 13° to Earth's and astronomers believe that its year is 17 months long. See also ASTEROID; ORBIT.

Eskimos' Way of Life, including their hunting, fishing, living, and other habits, is studied along with the customs and characteristics of other peoples in human geography.



Ewing Galloway

GEOGRAPHY

Pan American World Airways



Branson de Cou

Weather Balloons gather data on winds, temperatures, and other atmospheric conditions for use by specialists in meteorology and climatology, two of geography's many branches of scientific study.

Transportation Routes, including canals and other man-made and natural waterways, form an important subject of study in economic geography.

Distribution of Animals throughout the world is studied in animal geography. Llamas, found only in South America, are used there as pack animals.

GEOGRAPHY is the field of knowledge that studies the earth as man's home. Geographers are interested in where people, plants, and animals live, and where rivers, lakes, mountains, cities, and other natural and man-made geographic features are found. They study why these features are there, and how they are interrelated. The word *geography* comes from the Greek word *geographia*, which means *earth description*.

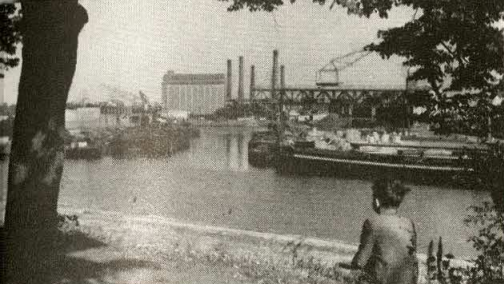
Geography depends greatly upon other fields of knowledge for basic information, particularly in some of its specialized branches. It takes material from chemistry, geology, mathematics, physics, astronomy, anthropology, and biology, and relates it to the study of man and his environment.

Geographers use a variety of techniques, such as

travel, reading, and the study of statistics. Maps serve as the geographer's most important tool and method of expression. Experts in geography increase their own knowledge by studying maps. They also add to man's storehouse of geographic knowledge by bringing maps up to date with their own specialized research.

Because a knowledge of geography is helpful to people in everyday life, the learning of various aspects of geography begins in kindergarten and continues through high school and college. Basic goals of the study of geography include an appreciation and understanding of direction, the ability to read maps, an understanding of space relationships, and knowledge of weather and climate.

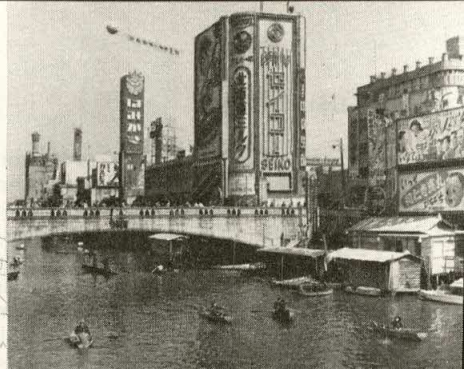
Men have always needed and used geographic knowl-



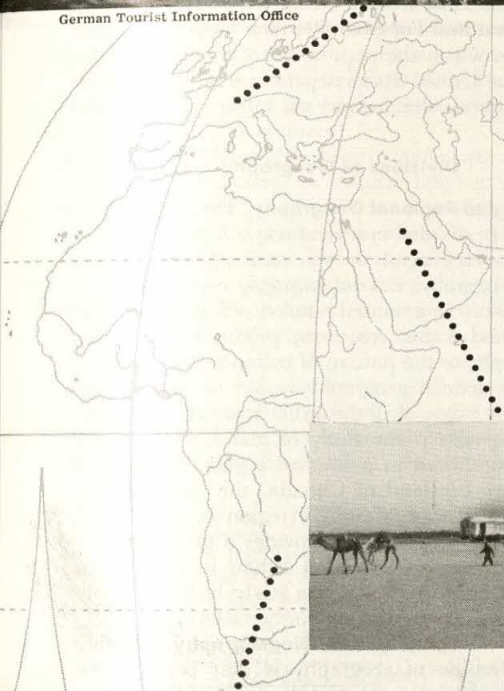
German Tourist Information Office

Distribution of Resources and the principles that govern their manufacture into finished products is an important area of geography studied particularly by economic geographers.

Location of Places, and the advantages and disadvantages of their location, is studied by geographers. Osaka, Japan, lies near the eastern entrance to the Inland Sea. Its position on many trade routes has helped it develop.



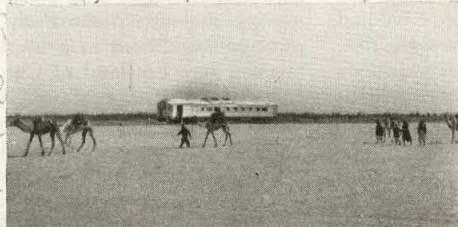
Bernd Lohse, Rapho-Guillumette



Political Geography deals with the political activities of man. It studies the systems men use for the production of raw materials and goods, such as this free-enterprise rubber plantation in the jungles of Asia.



Werner Bischof, Magnum



Arabian American Oil Co.

Historical Geography specializes in a study of past geography and on geographic changes through time. The gradual replacement of camel caravans by streamlined trains in Saudi Arabia has depended on many conditions, which historical geographers study.



Federal Information Department, Southern Rhodesia

Economic Geographers give special attention to the location of mineral deposits. They also study the reasons why men mine minerals in some regions and do not in others.



Edlay, Pix

Australian Aborigines hunt crocodiles for meat. They regard the tail of the crocodile as a particular delicacy. The study of man and the way his environment shapes his life is known as **anthropogeography**.

edge. Prehistoric peoples had to find caves to live in and a regular supply of water. They also had to live near a place where they could hunt wild animals. They knew the location of animal trails and of the trails followed by their enemies. They adjusted their daily work to the weather, and the gathering of wild seeds and fruits to the seasons. They used charred sticks or colored clay to draw primitive maps of their surroundings on the walls of caves and on the dried skins of animals.

In time, men learned to raise crops and to domesticate animals. These activities forced men to pay more attention to climate and to the location of pastures. They searched for soils in which crops would grow well, and they trained animals to carry them and their burdens from place to place. But early man's area of geo-

graphic knowledge probably did not extend much beyond the distance he could travel in one day.

We cannot be satisfied today with knowing the geography of only the area immediately surrounding our homes. It is not even enough for modern men to know about the lands and seas nearest them, as it was for men in the days of the Roman Empire. To satisfy our needs, we must know something about the geography of the whole earth.

The Main Ideas of Geography

The study of geography includes four main lines of inquiry. These are: (1) the location of features, places, and people; (2) what various parts of the world are like and how they differ from each other; (3) how the various

GEOGRAPHY

geographic features came to be where they are; and (4) the space relations of different features and areas to one another.

Location. One of the chief tasks of geography is to tell where places are and to interpret the advantages and disadvantages of their locations. As men began to move beyond their immediate homes, they needed to measure distances and to record these measurements. Early men drew crude maps to show distance and direction. When the great age of exploration began during the 1400's, map makers were more than ever needed to record the discoveries of new continents and oceans.

A map not only shows where a place is located, but also gives its position with respect to other places. For example, a map may show information about nearby mountains, lakes, or cities. See MAP.

What Places Are Like. Most persons are not satisfied to know merely the location of a place, such as Paris, Toronto, Chicago, Africa, or the Arctic. They want to know what kind of surroundings nature provides in the region, and what men have done there. They want to know how men have used the land, what types of houses they have built, how and where they have laid out roads, and what the people themselves are like. They want to know how the region resembles and differs from other places, and what these similarities and differences mean to man. Travelers once brought back this information by word of mouth. Today, man supplements such spoken reports with written records, with pictures taken on the ground and from the air, and with elaborate maps prepared with the aid of accurate surveying instruments.

The Changing Face of the Earth. Almost everyone has seen examples of changes in the earth's surface. Some of these changes are made by man, such as the clearance of a slum area or the altering of a river's course. Man-made changes usually occur much more rapidly than changes brought about by nature, such as the creation of a vast canyon by water erosion through thousands of years.

Many questions arise when geographers look at the changing earth. They want to know how the various features came to be where they are. They want to learn how men have changed the earth as they have lived on it. They want to know what the face of the earth was like in past times, and why cities grew up where they did. Geographers also want to discover why some areas of the world are so much more densely populated than others.

Space Relations interest geographers as well as astronomers. Astronomers study chiefly the relationships of the planets, stars, and other heavenly bodies. Geographers limit their study to the space relations of places and features on the earth. They study how the growth of a city has depended on a river, and how the depth and character of the water in the river have been affected by the city. Geographers view man in his space relations much as historians look at man's life in its time relations.

Geographers have always been concerned with man's relations to the earth. Earth conditions may limit what man can do, as in a desert, or provide rich conditions for living, as in a fertile river valley. Weather variations,

volcanic eruptions, and other changes in nature greatly influence what man does from day to day. In addition, man himself is a major cause of geographic change. He burns or destroys forests and grass, deepens and dams rivers, and causes soil to wash away. Efforts to offset the damages resulting from such changes by man form a major part of the conservation movement.

Geographers also study the connections between various other features. For example, they might investigate the ways in which the population of the Great Plains region of the United States depends on railroads, or the relation between climate and soil in the humid tropics of Africa.

Divisions of Geography

General and Regional Geography. The field of geography may be divided in several ways. A principal division is between general, or systematic, geography, and regional geography. *General geography* concentrates on the study of one or a limited number of features, such as weather, land forms, resources, production, distribution of people, or the pattern of transportation lines. A problem in general geography would be an analysis, with suitable maps, of all the airline routes in the world. *Regional geography* is the study of many, or all, of the principal conditions in a selected region, such as the Hudson Bay Lowland of Canada, the Po Valley in Italy, or the Rocky Mountain region of the United States. Regional geography provides a greater understanding of a certain area, and of how its various features fit together, than would a study limited to only one or a few features of the area. See REGION.

Physical Geography and Biogeography. Another common division of geography is that between the study of the physical earth and the study of living creatures. The study of the earth itself is called *physical geography*. The study of living things, their activities, and how they affect the physical earth is called *biogeography*. The advanced student of physical geography must have a knowledge of geology, meteorology, physics, and biology. The student of biogeography needs to know a great deal about botany, zoology, history, philosophy, politics, and various other studies of living things.

Branches of Physical Geography. Some physical geographers give most of their attention to the study of land forms, such as mountains and plains. Others study oceans, climate, or weather. One branch of physical geography deals with locating exact positions on the globe. Each of these branches is almost a separate science in itself and has a name of its own.

The study of land forms, or surface features, is called *physiography* or *geomorphology*. This science explains how forces within the earth raise mountains. It tells how erosion by winds, running water, landslides, and glaciers wears down mountains. It shows how materials worn away from high lands help form plains.

The branch called *mathematical geography* deals with space and time, with the shape of the earth, and with locating areas accurately on the globe. In order to locate places, geographers have marked off the earth's surface in lines called *meridians* and *parallels*. Any place in the world can be located by these lines.

Other branches of physical geography include oceanography, meteorology, and climatology. *Oceanography* is the study of the waves, tides, and currents of the

ocean, and also of the ocean depths. *Meteorology* deals with weather, wind, temperature, clouds, rain, and snow. *Climatology* is the study of climates.

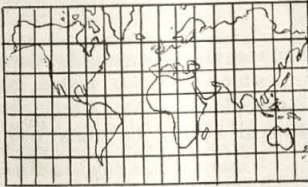
Branches of Biogeography. Travelers are frequently attracted by the varied plant life in different regions and countries. The specialist in *plant geography* studies climate, soils, and other factors that determine a region's plant life. The study of animals and birds of various regions is called *animal geography*. The animal geographer tries to determine why certain animals live in one region and others in another. One of the most interesting phases of animal geography is the study of migrations of birds and animals.

The field of *human geography* includes man and his environment, characteristics, customs, languages, religions, occupations, and needs. *Demography* deals with the study of populations in terms of births, deaths, marriages, and other data. The study of man and his environment is so important and has so many divisions that it practically makes up a science in itself. Geographers call it *anthropogeography*, which means *the geography of man*. Another branch, *economic or commercial geography*, deals with the industries of the world. The economic geographer studies agriculture and the reasons for its differences in various parts of the world. He investigates the distribution of raw materials and the

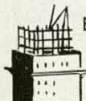
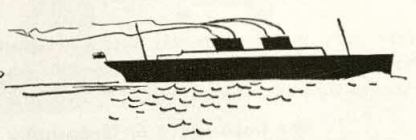
principles that govern their manufacture into finished products. He gives special attention to mineral resources and why men mine them in some regions but not in others. He studies trade routes, transportation facilities, and the great part that trade plays in the modern world. In a sense, economic geography is part of human geography, since it is man-made. But geographers have given it special study and treat it as a distinct branch. *Political geography* deals with the political activities of the human race, with human governments, with the size and boundaries of countries, and with the effects of political forces on the nature and arrangement of geographic features. An interesting problem in political geography would be to study the nations of the world that have changed their boundaries since the end of World War II, and the reasons why.

Contemporary and Historical Geography make up a third basic division of geography. Most geographic study stresses the modern world. Geographers have a primary responsibility to describe and interpret the current arrangement of geographic features. This study is related to the past, because the present grows out of the past. But every historical period has its own geography, because the passage of time changes the geography of

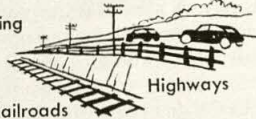
HOW MAN USES THE SCIENCE OF GEOGRAPHY



MATHEMATICAL GEOGRAPHY
Maps and charts for navigation



Building



Railroads

Highways

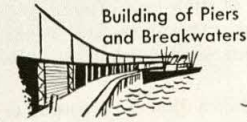


Farming

PHYSIOGRAPHY
Maps and charts of land forms



Shipping

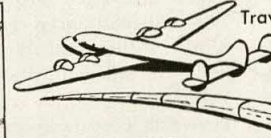
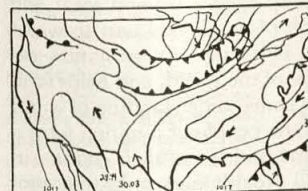


Building of Piers and Breakwaters



Fishing

OCEANOGRAPHY
Maps and charts of ocean depths, currents, tides



Travel

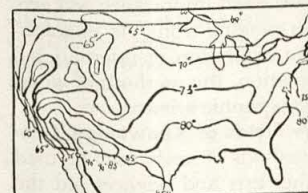


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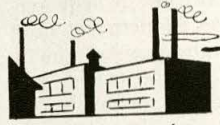


Farming

METEOROLOGY
Maps and charts of weather, winds, and temperatures



Farming



Location of Factories



Distribution of Merchandise

CLIMATOLOGY
Maps and charts of average weather



Geography Through Games. Children at Benjamin Franklin Elementary School in Pueblo, Colo., learn the location of each of the states on a large United States map painted on the playground.

John Rees, Black Star

every part of the earth. Historical geographers center their attention on past geography and on geographic changes through time.

The Importance of Geography

Curiosity About the Earth has always driven men to learn more about geography. A man's curiosity may be limited to exploring a stream near his home, or it may be strong enough to lead him to the far corners of the earth. When men travel and observe, they gain much of their geographic knowledge firsthand. But few, if any, men can visit every part of the earth. Most persons must acquire the greater part of their geographic knowledge from reading newspapers, magazines, and books; from studying maps; and from motion pictures, television, and radio.

A knowledge of geography can be a source of great enjoyment. Stamp collectors use geographic knowledge to organize their collections. They exhibit their stamps by countries, and often by larger geographic areas. Geography also provides the basis for many children's games which instruct as well as entertain. Both children and adults enjoy stories of travel at home and abroad. Some persons make a hobby of collecting early travel accounts or old maps.

Intellectual Development is aided by a knowledge of geography. Students study geography in elementary school, high school, and college because it helps prepare them for useful, successful lives. Modern men must think on a world scale, and geography furnishes a frame for this thinking. Men need to know the location and character of the principal natural and man-made features of the earth. They have to be familiar with world patterns of population, occupations, government, climate, land forms, natural resources, and routes of trade

and travel. People also need specialized geographic data about their own country, state, province, region, or locality. In addition, they should be aware of their dependence upon the physical earth and their own influence on it.

Geography, as a part of education, helps children and adults read with understanding. It enables them to interpret articles and graphs in magazines and newspapers, and to understand maps and photographs of many parts of the world. Of even more importance, it helps people fit events into their proper geographic setting.

Intelligent Citizenship. We can fully understand many public problems only if we have a knowledge of geography. In local and national affairs, decisions regarding such matters as water supply and irrigation depend on geographic understanding. The adjustment of city boundaries to suburban developments requires an understanding of local geography.

But intelligent citizenship ranges beyond local and national boundaries. Each of us plays a part in world affairs, either directly or indirectly. Every nation engages in trade with the rest of the world, and helps form world opinion. Only with some understanding of world economic geography can the people of a nation form a realistic attitude toward the position of their country in world trade. The natural wealth and industrial production of all countries have great importance and geographic interest. Problems ranging from the establishment of local parks to the regulation of international fisheries require the information, the methods of work, and the point of view of geographic science.

Cooperation with Other Fields of Knowledge. Geographic knowledge and methods of study may be used in other fields, just as other arts and sciences aid the

VISUAL AIDS HELP STUDENTS IN THE STUDY OF GEOGRAPHY



Students Often Make Relief Maps of areas they are learning about to help them visualize the way the land looks. The relief models are made out of plaster and other materials, then painted so that they resemble the region as seen from an airplane. An outline map of the model is then placed against a large wall map of the same area to show the students its proper location.

Oakland Public Schools

Working Volcano Model has been built by students to demonstrate the way in which volcanoes erupt. In making the model, students learned about various layers of the earth's crust and about the chambers of very hot magma which scientists believe exist 20 to 40 miles below volcanoes. They learned that a passage called a conduit carries explosive gases and rock to the surface. They discovered that these gases are so hot that they will sooner or later reach the weaker places in the earth's crust as a means of escape.

H. Armstrong Roberts



Globes and Maps are the most valuable visual aids used in the study of geography. They are so important because they help to explain most of geography's main lines of inquiry. Globes and maps show students the location of features, places, and people. They give an idea of what various parts of the world are like and how they differ from each other. They also enable students to grasp the space relations between different features and areas.

Pittsburgh Public Schools



GEOGRAPHY

geographer. The student of geography depends greatly on a knowledge of history. He also contributes to historical knowledge by helping to place persons, events, and historical developments in their geographic settings. For example, an understanding of the military strategy of General "Stonewall" Jackson in the Civil War requires a knowledge of the nature and arrangement of land forms in Virginia.

Geography cooperates with other arts and sciences in the study of such problems as conservation, the relation of population to resources, and the origin and spread of plants and animals throughout the world.

Aid to Intelligent Travel. Geographic knowledge contributes to intelligent and rewarding travel. It sheds light on any area in the world that man might visit. Geography might tell the meaning of the rounded stones over which a traveler walks in descending to a riverbank. Or it might provide an understanding of the broad pattern of the Appalachian Mountains which a traveler crosses in the eastern United States. Geography might tell the traveler why many of the highest peaks of the Alps are pyramid-shaped, why citrus fruits thrive in Florida, and why the ostrich of Africa and the reha of South America are similar. An understanding of geographic concepts, and a knowledge of geography's many interesting and interrelated facts enlighten the traveler, and make traveling more educational and satisfying.

In Business. Geography has practical value in many fields of business. For example, manufacturers must know the sources of their raw materials. They must know the means and routes of transportation, and the needs of the markets they hope to serve. Goods shipped to markets in certain regions may require special packaging to withstand the weather of the rainy tropics or

the sunny desert. The farmer must have a detailed knowledge of the soils and topography of his land and must be familiar with the weather and climate. He should know the conditions in other regions which produce the same crops that he grows.

The Growth of Geography

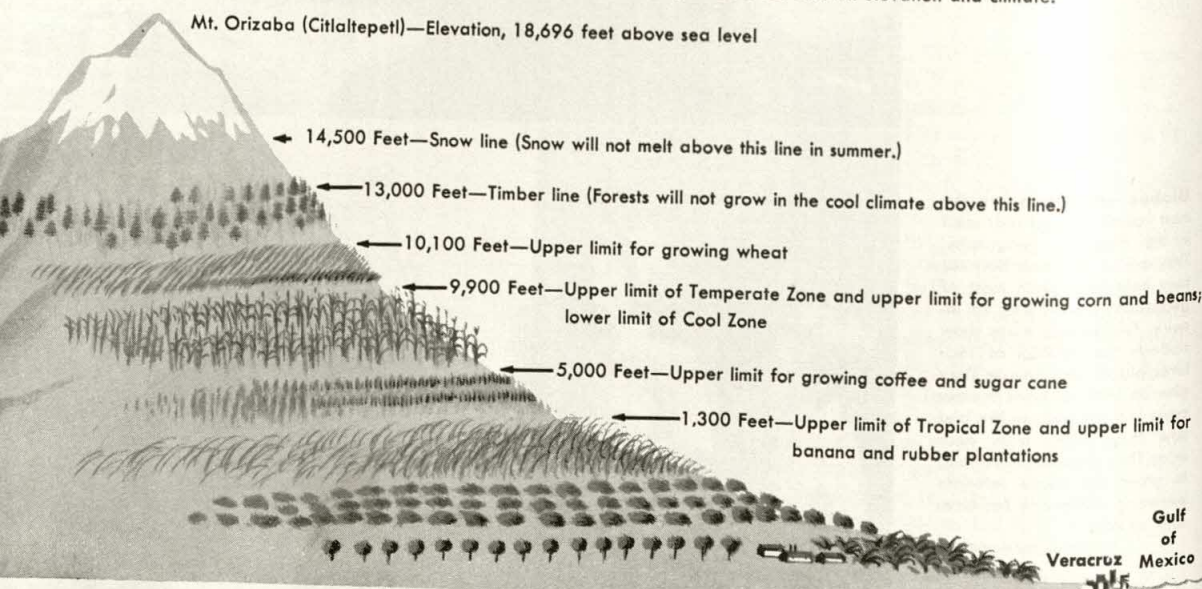
Beginnings. Knowledge of geography began to grow when men first traveled. Perhaps some primitive man living by the sea carried a skin bag full of salt into the mountains to trade with hunting peoples for a bearskin. He gained geographic knowledge on the journey through his own country and that of his neighbors.

The Greeks were the first people of the Western World to make a study of geography. They knew and mapped the seacoasts near their country. They sailed the Mediterranean Sea and made overland journeys into Africa. During the 200's B.C., a Greek geographer named Eratosthenes correctly figured out that the world is about 25,000 miles around. Other peoples had traveled before the Greeks did. But the Greeks wanted to know the reasons for the differences in the way people lived. They made records of what they saw, and that is why they are called the first true geographers. The Romans were great map makers. They measured distances to cities far from the sea and placed them accurately on maps.

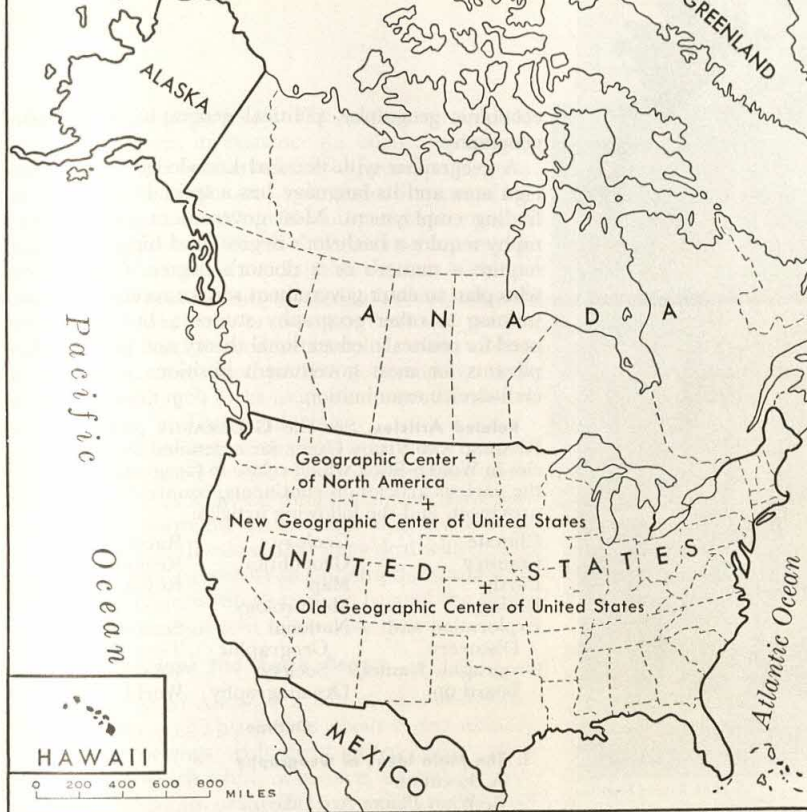
In the early Middle Ages, much of this Greek and Roman knowledge was lost to the world. At that time, the Arabs of Arabia and North Africa were the best geographers. The Arabs, like the Greeks, knew that the world was round.

Explorations. Gradually, the peoples of western Europe began making journeys. Some traveled to the Holy Land. They started to draw maps of their journeys. Unexplored areas were pictured on maps with terrible monsters and sea serpents. In the 1200's, Marco Polo

The Earth as Man's Home is the Main Subject of Geography. This drawing shows the land surface of Mexico from Mt. Orizaba, at the edge of Mexico's central plateau, eastward to the Gulf of Mexico. It helps explain the location of Veracruz and its growth into a large city. It also shows that the crops man can raise depend not only on soils but also on elevation and climate.



Adapted drawing from *Neighbors in Latin America* by Carls, Sorenson and Howarth, © 1951, the John C. Winston Co.



GEOGRAPHY

New Geographic Center of the United States, since Alaska and Hawaii gained statehood in 1959, lies about 17 miles west of Castle Rock, S. Dak. It replaced a point in Smith County, Kansas, as the center of the nation. The geographic center of the North American continent is near Rugby, N. Dak.

Although geographers study chiefly the world of their time, their work always combines knowledge of both past and present. Even the simplest map may reflect discoveries and long hours of labor by many persons stretching back through the years. The map itself, however, may have been reproduced

traveled by land from Europe to Cathay, or China. He was taken prisoner in a naval battle after his return. While in prison, he told his many adventures to a cell mate who wrote them down. *The Book of Marco Polo* is famous even today. Much of the book may properly be called geography.

Before the 1400's, Europeans had little knowledge of geography. They knew of only about 7 per cent of the water surface of the world. But during the 1400's and 1500's, the Spaniards and Portuguese began sailing the oceans. Christopher Columbus, an Italian in the service of Spain, discovered America in 1492. The Portuguese explorer Vasco da Gama sailed around Africa and reached India in 1497. An expedition started in 1519 by Ferdinand Magellan, a Portuguese, sailed around the world, although Magellan was killed on the way. The Dutch, English, and French also began exploring during this period. Many explorers looked for a Northwest Passage to the East. Francis Drake, an English sea captain, sailed around the world between 1577 and 1580. In less than a hundred years, Europe had become aware of the other 93 per cent of the earth's water surface. See **EXPLORATION AND DISCOVERY**.

Maps. Central Africa was not explored until the 1800's, and Europeans did not have knowledge of all Arabia before the 1900's. Until the 1940's, men knew little of the geography of the great continent of Antarctica. World War II greatly increased geographic knowledge of many out-of-the-way places, including the ocean floor, the last large part of the earth to be explored. During the war, governments made and printed more maps than had been made throughout the previous history of the world. Today, by means of aerial photographs, men can map remote jungles and valleys hidden in the mountains. With this new knowledge, geographers are making new maps of the world.

by the most modern methods of color printing, as are the maps in **THE WORLD BOOK ENCYCLOPEDIA**.

Famous Geographers. Men from many walks of life have contributed to the growth of geographic knowledge. The geography of North America became known through commerce, conquest, and colonization. Fur traders traced its rivers, and armies such as that commanded by George Washington marched across its virgin lands. American settlers gradually pushed the frontier ever westward toward the Pacific Ocean.

Through the centuries, many geographers have been aided by a zeal for exploring and writing about their travels. The Greek writer Herodotus traveled widely in the eastern Mediterranean region during the 400's B.C., and recorded his observations and reflections. About 400 years later, another Greek, Strabo, wrote famous descriptions of the world of his time. Curiosity and scholarship spurred Richard Hakluyt, an English clergyman, to collect and translate old travel records in the 1500's. This same zeal encouraged Alexander von Humboldt of Germany in his travels through the Americas during the early 1800's. It led John C. Frémont to explore the lands that now make up the southwestern United States.

Geography became important in Europe as a separate field of study because of the work of Humboldt and Karl Ritter, a German contemporary. History credits them with giving new life to this age-old field of study. They established geography as a subject of university study more than a hundred years ago.

Careers in Geography

Geographers working in the various fields of geography use many different methods of study. Some specialize in field study, in traveling and recording what they see, or in interpreting photographs. Others prefer



© 1955 Babson Institute

Huge Steel Globe of the World, covered with about 500 plates that can be changed as the political boundaries of the world change, aids geography students at the Babson Institute at Wellesley, Mass.

library and statistical study, and have special skill in handling documents and statistics. But all geographers depend on the services of the *cartographer*, or map maker. Cartography employs more geographers than any other field except teaching. More than half of all geographers are teachers. Business and government agencies employ most of the rest.

Teaching. Students can study geography at all levels of education, from elementary school through graduate school. Most elementary and high schools require a geography teacher to have a bachelor's degree. A master's degree is usually the minimum requirement for teaching geography in a university or college. Most permanent university positions require teachers to have a doctor's degree. The university geography instructor not only teaches, but also often adds to man's knowledge through research.

In Business, the geographer may find employment as a writer of magazine articles, or as an editor. He may work as a cartographer for a map-making company or for a textbook publisher. He also may use his training in the real-estate business, or as a marketing consultant.

In Government. Federal, state, and municipal agencies in the United States employ hundreds of geographers. Some work with city and state planning commissions, and others serve on the staffs of state conservation departments. About 200 geographers work for the Department of Defense. Other branches of the federal government also employ many geographers. More than half of all government geographers gather information for maps, make maps, or act as map librarians. Others work in the fields of agricultural geography,

economic geography, political geography, and urban geography.

A geographer with detailed knowledge of some foreign area and its language has a special advantage in finding employment. Most government jobs in geography require a bachelor's degree, and higher positions require a master's or a doctor's degree. Geographers who plan to enter government service receive the same training as other geography students, but have little need for courses in educational theory and practice. Applicants for most government positions must pass a civil-service examination.

J. RUSSELL WHITAKER

Related Articles. See the GEOGRAPHY section of the READING AND STUDY GUIDE for a detailed list of the articles in WORLD BOOK which relate to Geography. See also the various articles on continents, countries, states, and provinces, and the following articles:

Climate	Geology	Races of Man
Country	Geopolitics	Region
Earth	Map	Royal Geographical Society
Ecology	Meteorology	Season
Exploration and Discovery	National Geographic Society	Time
Geographic Names, Board on	Oceanography	Weather
		World

Outline

- I. The Main Ideas of Geography
 - A. Location
 - B. What Places Are Like
 - C. The Changing Face of the Earth
 - D. Space Relations
- II. Divisions of Geography
 - A. General and Regional Geography
 - B. Physical Geography and Biogeography
 - C. Contemporary and Historical Geography
- III. The Importance of Geography
 - A. Curiosity About the Earth
 - B. Intellectual Development
 - C. Intelligent Citizenship
 - D. Cooperation with Other Fields of Knowledge
 - E. Aid to Intelligent Travel
 - F. In Business
- IV. The Growth of Geography
 - A. Beginnings
 - B. Explorations
 - C. Maps
 - D. Famous Geographers
- V. Careers in Geography
 - A. Teaching
 - B. In Business
 - C. In Government

Questions

Who were the first people of the Western World to make a study of geography?

What did a sea serpent indicate on early maps?

Who were the best geographers of the Middle Ages?

What two occupations employ the most geographers?

What four principal questions does geography answer?

What are several main divisions of geography?

What is the difference between biogeography and physical geography?

What were the contributions to geography of (1) Eratosthenes? (2) Herodotus? (3) Strabo? (4) Marco Polo? (5) Richard Hakluyt?

What is the basic tool of all geographers?

Why is geography so important in everyday life?

GEOLOGICAL SURVEY, in the United States and Canada, is a government bureau that makes studies of the land and its resources. The United States Geological Survey was founded in 1879 as a bureau of the Department of the Interior. It furnishes reliable information about the location of mineral deposits, and detailed maps. The Geological Survey of Canada was established in 1842.

MARGARET WILLIS

GEOLOGY, *jee AHL oh jih*. The earth is very old. It probably has been in existence for about four billion years. During that time, much has happened to it. Lava has flowed from cracks and volcanoes. Streams of ice have moved down mountainsides or spread over prairies and hills. Seas have advanced across sinking continents, while layers of sand and mud settled on their bottoms. Later those sea bottoms turned into land, where rain and streams wore rocks away or frost split them into pieces. At other times land heaved or crumpled, while molten stuff much like lava filled pockets deep underground. There it formed such rocks as granite or produced ores of iron, copper, and other minerals.

Geology is the science that deals with these changes, as well as with their results. It also determines when they happen. It traces living things of ancient ages, and describes their surroundings on land, in fresh water, or in the sea. Special divisions of geology deal with ores of minerals, with the causes of volcanic eruptions, and with various other subjects. Some even go beyond the earth, to find how it became part of the solar system.

How the Earth Began

The earth, as we know, is a ball of rock and water surrounded by air. This ball is about 8,000 miles in diameter. It belongs with eight other balls, called planets, all of which whirl, or revolve, around the sun. With them go moons, or satellites, as well as a thousand or more smaller balls, billions of meteors, and the huge, tailed affairs known as comets. These and the sun itself make up the solar system.

The Nebular Theory. Scientists agree that the solar system had a beginning, during which the earth and other planets came from the original sun. Until about 1910, most scientists also accepted Laplace's *nebular theory* as an explanation of how this happened.

Pierre de Laplace was a French astronomer who first proposed his theory in 1796. He thought that the solar system began as a *nebula*, or ball-shaped cloud of hot gas, which rotated rapidly and spread out into space beyond the most distant planet. The nebula cooled and started to shrink, but it also rotated so fast that gas bulged from its equator, forming ring after ring. Those rings rolled into balls which became the planets. The gas that remained in the nebula condensed and became the sun.

The ball of gas that became the earth also bulged, throwing off a ring that turned into the moon. The ball then cooled and shrank, becoming a sphere of molten rock. In time its surface formed a crust which became thicker and thicker as the earth lost more and more heat. Large parts of the crust became cold, though the molten interior still broke through in the form of volcanic eruptions or hot lava that flowed from cracks. That, said followers of Laplace, is the condition in which the earth is found today.

New discoveries proved that Laplace's theory was wrong. Astronomers found that the nebula never could have been so large as Laplace supposed, nor could it have been so hot. Physicists discovered that a ball of gas could not form rings, nor could rings roll themselves into planets. Geologists proved that eruptions do not come from a molten core in the earth, which really is more rigid than steel. Other geologists found that the earth's surface has not cooled gradually, since cold ages



Edward Clark, *Life*, © 1955 Time Inc.

The Earth's Crust Buckled in Early Geological Ages and formed mountains and valleys. Geologists demonstrate this by spreading moist clay on stretched rubber and letting it shrink.

and warm ones have alternated with each other for a period of hundreds of millions of years.

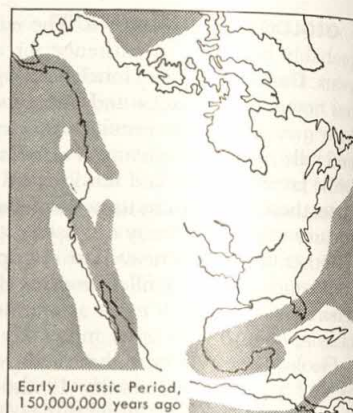
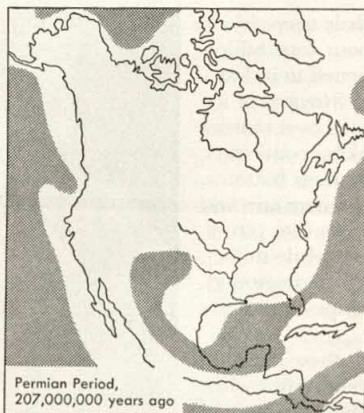
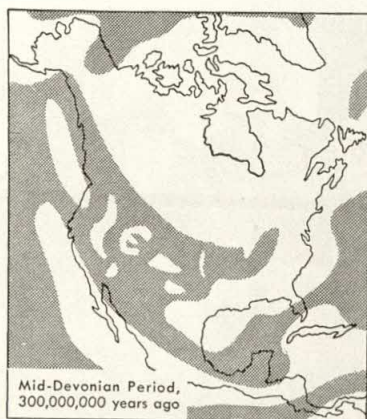
The Planetesimal Hypothesis. A new explanation was developed by Thomas Chrowder Chamberlin (1843-1928) and Forest R. Moulton of the University of Chicago. They began with the sun, a bit bigger than it is today, but otherwise about the same. For ages it traveled through space undisturbed, till at last a small star approached it. Closer and closer came the star, swinging along in a curve that would take it past the sun. It raised huge, stormy tides at the sun's equator. They burst into clouds of gas which shot outward toward the star. As the star disappeared the clouds escaped the pull of the star and began to travel around the sun like the arms of a huge pinwheel.

The clouds were hot and gaseous at first. Soon they began to cool, condensing into solid lumps which Chamberlin called *planetesimals* because they whirled around the sun as if they were tiny planets. As they did so, they bumped into each other. When that happened, small lumps always joined the large ones.

The earth began as one of the large planetesimals, or perhaps as a swarm of them which collected into a ball. It grew by bumping into smaller masses. At first its surface was rocky and bare, but when it reached half its present diameter it began to hold a cover of air. Soon it also began to hold water—first as gas, or vapor, in the air, and then as moisture that formed drops and fell on the rocky planet. This early rain moistened land, made streams, and finally filled low places which became the earth's first seas. From that time on, our planet was essentially what it is today, even though it kept on growing by swallowing planetesimals. The formation of the planet took about 20,000,000 years.

Other Explanations. Other scientists developed other explanations. Some said that planetesimals must have crashed together with such force that the earth became a molten mass which later cooled and hardened. Others thought the star must have come so close that it pulled out a single streamer of gas that broke into several sections, which then turned into balls. Some of those balls remained gaseous, but the one which formed the earth became molten and then hardened into stone.

We cannot tell which of these ideas is best although



The Shape of North America Changed in Various Geological Periods (White Stands for Land, Gray for Water).

many scientists believe that the planetesimal hypothesis seems to fit geologic facts better than other theories.

How the Earth Has Changed

The earth has gone through many changes. For thousands of years men have wondered how and why it did so. Their first explanations were myths or guesses, since no one knew what was in our planet nor much about its surface. One wise man of ancient Greece told how a god had torn mountains apart, making a narrow gorge. Others said that earthquakes were caused by gales that rushed into great caves, and that volcanic eruptions were caused by winds that whipped through deeply buried caverns until friction turned them into fire.

In time these guesses were forgotten, but new ones took their places. In 1800 a German geologist named Werner taught his students that a sea once had covered the entire earth to a depth of several miles. Rocks of all kinds settled in the water. The first ones to form made mountains, said Werner, but the last built low flat plains. Other geologists described imaginary floods which dug valleys in an hour or two, and carried boulders weighing many tons from mountain to mountain or from mountain ranges to plains.

James Hutton and Sir Charles Lyell. A revolt against such guesswork began in Scotland about 1795. There, James Hutton (1726-1797), a former doctor and farmer, published a book which showed that rushing streams were deep gorges. Hutton indicated that sandstone was only hardened beds of sand, and that such ancient rocks as basalt were like lava from modern volcanoes. In short, said Hutton, the earth is changing now as it did long ago, and is making new rocks like those found in plains or mountains.

Charles Lyell, a Scot who lived in London, accepted this idea. In a book called *Principles of Geology* and published in 1830-1833, Lyell told how rains and rivers wear hills away, how eruptions build lava plains or mountains, and how waves destroy rocky seashores but build up beaches and bars. He also traced such changes in ancient rocks. They proved, said Lyell, that Hutton was right. Earth is changing now as it changed long ago. To find out what happened in ancient times we must learn what is happening today.

Volcanoes and Lava Flows. Werner had said that ancient lavas had settled in water, and that volcanoes were recent affairs of very little importance. Geologists

who followed Hutton and Lyell proved that both these statements were wrong. They found that lava comes from pockets of molten rock several miles underground, but far from the earth's center. Two pockets which lie very near each other may produce different kinds of lava and erupt at different times.

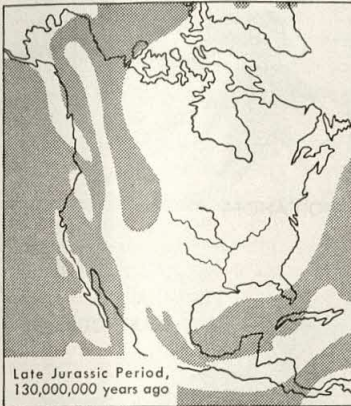
There are many volcanoes in North America, but most of them have stopped erupting. Now and then, however, a new one appears. This happened in 1943, when eruptions began in a field near the Mexican village of Parícutin. Within a year the eruptions sent out clouds of exploded lava, or "cinders," which covered the country for miles around and piled up in a cone-shaped volcano 15,500 feet in height. Lava also ran out of the ground, rolling along in streams of hot rock which hardened and broke into blocks as it moved. Such lava streams and volcanoes can be found in the western United States from Arizona to Washington. Larger volcanoes include Mount Shasta and Mount Rainier.

Molten Rock Underground. Not all molten rock comes to the surface, where it can turn into lava. A great deal stays deep underground, cooling until it hardens into such rocks as granite. We discover these hardened masses where the rocks which once covered them have been worn away. This has happened in such mountains as the Sierra Nevada of California, the Coast Range of British Columbia, and the Rockies of Colorado. It also has happened in very old mountains.

In many places molten rock forced its way into cracks or spread out between older formations. When the rocks around it are worn away, the hardened lava looks like walls or colored bands that run across hills and cliffs.

Movement of Sea and Land. When we speak about the land moving, we generally think of earthquakes. In 1899, an earthquake was caused in Alaska when part of the shore near Yakutat Bay moved upward 47 feet. In 1906, another earthquake shook parts of California as the land broke and moved sideways from 2 to 21 feet.

There have been countless earthquakes in the past, as we can tell from breaks which caused them. These breaks are known as *faults*. They cut across layers on rock formations as sharply as the cut of a knife. Some are very small. Others are miles in length and show that rocks moved upward or downward for hundreds and even thousands of feet. Between California and eastern Utah, such faults have divided the country into long blocks which still are rising or sinking. Blocks that have



The Shape of North America Changed in Various Geological Periods (White Stands for Land, Gray for Water).

risen form mountain ranges, while those that have sunk are valleys.

In other places the earth's surface shifts slowly — perhaps less than an inch per year. Sinking often lowers land into the sea, which covers flat regions and turns valleys into irregular bays. Uplift, on the other hand, turns sea bottoms into land. Large parts of our continent consist of old sea bottoms which were raised until they formed land. This movement upward of the earth is called *diastrophism*.

The Appalachian Mountains show what happens when thick formations of rock are squeezed as parts of the earth's surface shrink. In time the rock begins to bend, crumpling into great up-and-down folds which form mountain ranges and valleys. In some places the folded formations break, after which they are pushed over younger rocks in what are called *thrust faults*. Thrust faults are found in the Appalachians, though they do not show as plainly as one in the Rocky Mountains at Glacier National Park, Montana.

Rocks Are Remade. Lava sometimes breaks off pieces of granite or limestone, heats them, and carries them out of volcanoes. Molten rock, deep underground, caused much greater changes during ancient times. It heated and squeezed older formations, breaking some of them into chips, while others became glassy or were turned into marble. Steam often came from the molten rock, bringing dissolved mineral matter which combined with materials in nearby rocks, or settled in cracks and pores. Steam thus produced ores of copper, silver, tin and other metals. It turned hardened lava into asbestos, and remade shales, sandstones, or limestones until they looked like granite. Granite itself was turned into a banded rock known as *gneiss*.

Such changes are called *metamorphism*, as are those produced where rocks were squeezed and crumpled. This process transformed mineral grains into flat plates or scales and arranged them in layers. Shale thus was remade into slate, while several kinds of rock were turned into thin-layered, shiny material called *schist*. In Pennsylvania, soft coal was squeezed and hardened until it formed anthracite. To make sure how this happened, geologists have repeated the process in laboratories.

Erosion and Deposition

All these changes come from inside the earth. Some changes, such as eruptions and faults, may begin miles

underground. Other changes, however, start at the surface and are caused by such familiar things as weather, rivers, or ice.

Weathering Destroys Rock. People who climb Lassen Peak, a volcano in California, cross slopes of broken rock that formed when hot, hard lava cooled and cracked into countless pieces. In most places, however, such loose stones have been broken by frost or other weather conditions. This kind of change is called *weathering*.

Frost consists of tiny crystals of ice which swell each time they freeze. Swelling produces pressures of hundreds or thousands of pounds per square inch. It makes new cracks that cut through rocks. It also makes old cracks deeper and wider, till they divide thick ledges into blocks, or split boulders into sharp pieces of stone.

Other processes help frost in its work of destroying rocks. Loose blocks tumble down hills or mountains, breaking to bits as they go. Air and water get into the ground, carrying substances that combine with grains of mineral matter. The new compounds generally are larger and softer than the originals. They loosen flakes or chips of stone, or make massive rocks so weak or "rotten" that they crumble into heaps of sand. Certain compounds dissolve and are washed away, making rocks smaller and smaller till only rough lumps remain. Even plants help in weathering, for their roots grow in cracks and create pressure that works like ice. See **Rock**.

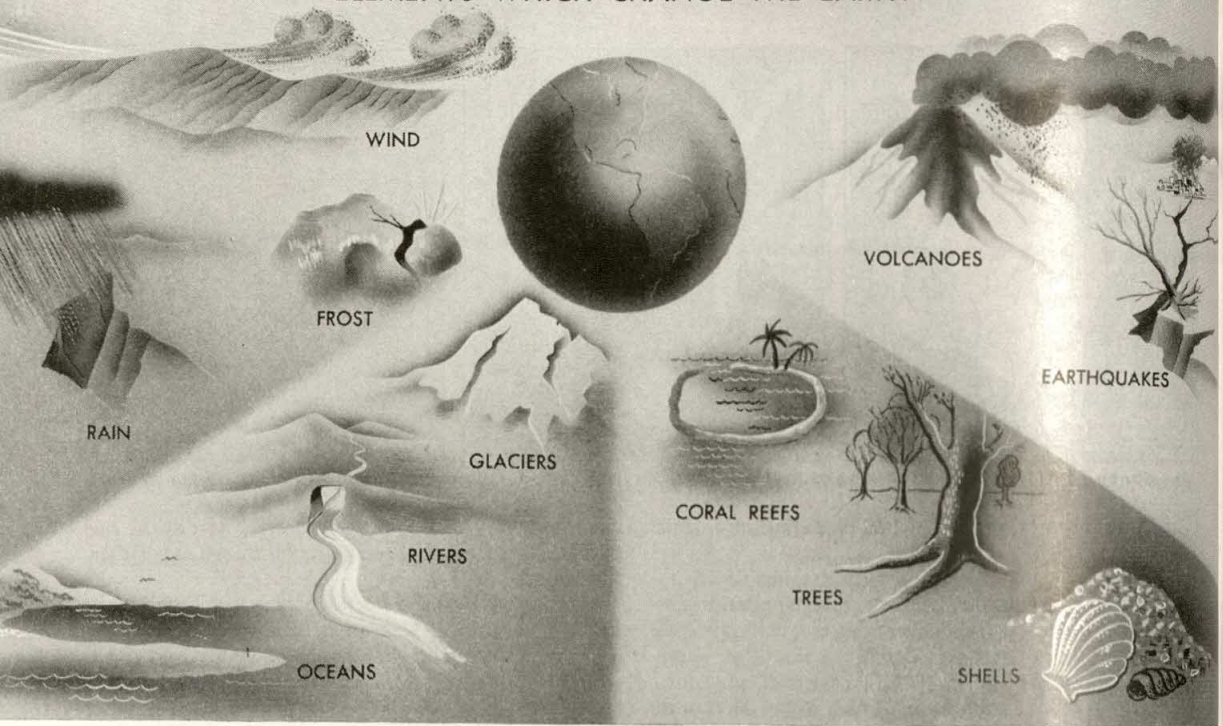
Work of the Wind. Wind blows dust and sand from places where the land is bare. In 1934, a single wind-storm blew 300,000,000 tons of dust from dry plains in the West and carried much of it eastward to the Atlantic Ocean. On deserts, winds blow sand as well as dust, polishing loose stones and wearing deep pits in cliffs.

This process has been going on for ages, blowing dust and sand into rivers and to the sea. Wind-blown sand also settles in hills known as *dunes*, which have been found in beds of sandstone 400,000,000 years old. Beds of wind-blown dust, not nearly so ancient, are found on plains in the West and in the Mississippi Valley.

Running Water Destroys. Many early geologists believed that valleys were made by earthquakes or by tremendous floods. They could not believe that running water is able to destroy land.

We can see it do so as we watch rain beat down on a steep, bare bank. The water runs into low places, where it picks up grains of clay or soil and carries them downhill. This goes on till each low place becomes a gully,

ELEMENTS WHICH CHANGE THE EARTH



through which more rain water can flow at faster and faster speeds. It also will carry more clay, sand, or soil grains, thus destroying still more land.

Gullies grow into ravines and then into canyons where streams that flow year after year keep up the work of destruction. The Grand Canyon of Arizona shows how much they can do. Though it is a mile deep and ten miles wide, rains and the Colorado River have dug it in barely 2,000,000 years. The valley of the Mississippi is longer and wider, and so are the valleys of many tributary streams. Each year those tributaries and the Mississippi take 441,000,000 tons of rock to the sea.

Water changes the land surface as it wears rocks away. Northern Arizona once was a level plateau. Now it is cut by the Grand Canyon, in which the river has left remnants that are larger than any mountains. The modern Appalachian Mountains consist of strong, folded rocks which were left as steep ridges while weak beds between them were destroyed. In time, streams will cut those ridges down, turning the mountainous country into a level plain.

Rivers themselves go through changes as they wear the land. Young streams are narrow and flow swiftly. Often they rush through rapids or tumble over falls. As centuries pass the rivers grow wider and do not flow so fast. At last they spread out and become sluggish, winding to and fro between mud banks or meandering in curves. The swift Colorado is a good example of a young stream. The Mississippi is one that has become old.

Water in the Ground. Not all rain water runs directly into streams. Much of it soaks into the ground. There it seeps from crack to crack or travels through tilted beds of sandstone or other coarse-grained rock. In these beds the water may travel for miles. Wells in eastern Nebraska, for example, pump water which soaked into sandstone near the Rockies of Colorado. In other places, water travels only a few miles before it comes back to

the surface, where it flows out in the form of springs.

As water seeps through rocks it dissolves mineral particles and carries them away. Sometimes this makes cracks wider. Sometimes it leaves holes which grow larger and larger until they become caves. In the limestone region of Kentucky, for example, water has dissolved substances and produced caves whose total length is about 100,000 miles. A single "room" of another cave in New Mexico is 350 feet high, 600 feet wide, and three quarters of a mile in length. A spring that comes to the surface near that cave carries off 2,500 tons of mineral matter every month of the year.

In Yellowstone National Park and some other regions, water seeps down to buried lava which still is very hot. This soon heats the water, which then comes back to the surface and bubbles out in hot springs. *Geysers* are hot springs which erupt because steam gathers in cracks and holes underground until the pressure is great enough to blow the heated water out. Old Faithful geyser, in Yellowstone Park, erupts 10,000 to 12,000 gallons of hot water in about four minutes. It then is quiet for about an hour, while enough steam collects underground to cause another eruption.

Both hot water and steam dissolve minerals while they are in the ground. At the surface these minerals settle and harden, forming glassy or limy deposits around both geysers and springs. Travertine, a hard but porous rock often used in the floors and walls of public buildings, is a limy deposit left by ancient hot springs.

Seas Destroy and Build. Have you ever stood on a seacoast while waves came rolling in? As those waves reach the shore they break into foam or splash through the air as spray. They also push their way into cracks, which grow wider and wider until blocks break off and fall into the water. If the shore is made of clay, shale, or sand, the waves break off so many small pieces or grains that the water becomes muddy.

This process goes on day after day and century after century. It is helped by loose pebbles and rocks, which the waves roll against each other and pound against the shore. Thus they batter more pieces of rock from the land and wear those that have broken from it into smaller and smaller pieces. In time they become sand or mud which can be carried away by coastal drift currents.

Hard, rocky shores may change slowly, though caves and crumbling points show that land is being worn away. Shores made of sand, clay, or shale are so much less resistant that waves may destroy them at rates of several feet per year. In England, waves destroyed a strip of land one mile wide in less than 900 years.

SOME TERMS USED IN GEOLOGY

Alluvium, a *LYU vih um*. The products of erosion, chiefly sand, gravel, silt, mud, and clay, are deposited either at the bottoms of streams and rivers, along their banks, or at their mouths, where they form deltas. These deposits are known as alluvium, or alluvial deposits. The large tracts of fertile land in the valleys and along the banks of many rivers have been formed by alluvial deposits left there by the streams.

Batholith is an intrusion of igneous rock that has come from under the earth and lies under surface features.

Bed. In geology, a **bed** or **stratum** is one layer in a series of rocks that consists of many layers, and therefore is called *bedded* or *stratified*. One says such a rock mass shows "bedding" or "stratification." Each bed may differ from the next in coarseness, color, mineral composition, or some other feature, or the beds may be closely alike in these respects; but each is separated from the next by a distinct surface, called a *bedding plane*.

In some stratified rocks, especially fine-grained ones, each bed is made up of thinner, less distinct layers, called *laminae*. This structure is *lamination*. In some rocks deposited by strong currents, laminae in each bed are tilted toward the bedding planes. Such a structure is known as *diagonal lamination*, or *cross-bedding*, and the rocks are said to be *cross-bedded*.

Bedrock is the solid rock one always finds beneath loose materials, such as soil, river mud, or windblown sand, when one digs or drills deep enough. The loose soil, mud, and sand are called "mantle rock." The solid rock beneath it is the "bedrock."

Cleavage, *KLEEV ih*, is the property possessed by some metamorphic rocks and by many crystalline minerals of being divisible in certain directions into layers or thin sheets. The flat surfaces separating the layers are called *cleavage planes*. The cleavage of rocks is something very different from that of minerals.

Cleavage, in both rocks and minerals, may be an advantage or disadvantage, according to the purpose for which the material is to be used. In the manufacture of roofing slates, the rock is split along its cleavage planes. The usefulness of mica in industry depends largely on its cleavage. See **METAMORPHISM**.

Deposition is one of the constructive agencies ever at work on earth. Deposition of sediments is termed *sedimentation*, and mineral deposition is called *mineralization*. Geologists study the rate of sedimentation as one way of determining the age of the earth.

Dike, in geology, is a body of rock that occupies a crack or fissure cutting across rocks older than itself. Most dikes were formed when liquid molten rock rose from far below the earth's surface and forced its way into cracks in the rocks higher up.

In many cases the dike rock is harder and disintegrates slower than the rock on either side, and may be left standing like a wall as the side rock crumbles away under the action of rain and frost. In others, however, the dike rock decays faster, leaving a trenchlike depression on the surface. In sea cliffs, such softer dikes are eroded out to form narrow, deep chasms.

Much of the material which waves wear from land is carried out to sea. Some of it, however, is piled up near shore in sand bars, spits, and beaches. Coney Island, off Long Island, was built in this way.

Glaciers Change the Land. Glaciers are streams or broad sheets of ice which move down mountainsides or over low country. As they move, they break off blocks of rock and pry others out of the ground. The moving ice rubs these blocks against each other and scrapes them against the bedrock over which it travels. This scours the surface and grinds broken blocks into smaller and

Dip. Sedimentary rocks are formed on the floors of oceans, inland seas, or lands, and lie in a horizontal position when deposited. In places they have been raised hundreds or thousands of feet to their present exposures. Some are still nearly flat, as in the Great Plains; others have been tilted at various angles, as in the Appalachian Mountains. Some stand on edge, or are more or less completely overturned.

The terms *strike* and *dip* are used to describe the position in which a layer of rock lies. Dip is the amount of slope measured on a tilted layer of rock. Strike is the direction in which a bed of rock lies level.

Drift may be used for any deposit of loose material, derived from weathering of rocks, that has been transported to its present position by waves, streams, winds, or ice. Generally, however, the term refers to glacial drift. In this sense, the term includes material ranging in coarseness from great boulders to the finest rock dust. The parts of the drift laid down directly by the melting glacier are known by the collective name of *till*, and the drift deposited by water flowing from the melting ice is called *stratified drift*, or *glacial outwash*.

Escarpment is a steep slope or cliff, caused generally by erosion. Typical examples are the Mogollon Rim in Arizona and cliffs in Bryce Canyon and Zion national parks. The Niagara escarpment separates different heights of land. See **NIAGARA FALLS AND NIAGARA RIVER**.

Fault, in geology, is a relative displacement of the two masses of rock separated by a break. The surfaces on which such movements take place are called *fault planes*. Fault planes may have any inclination from horizontal to vertical, and the relative movement of the rocks may be in any direction and of any sort.

Fulgurite is partially fused sand lying on the surface of sand dunes in the form of rods and tubes. Fulgurite is formed where lightning has struck the loose sand, melting some of it.

Joint, in geology, is one of the even cracks that divide most large masses of rock into somewhat regular blocks. Joints are of two general sorts—*torsion* joints and *shrinkage* joints—although a few are formed in other ways. Torsion joints are produced in the warping and folding of rocks under great stress. They cut cleanly through rocks of all kinds, regardless of texture or coarseness of grain. Shrinkage joints are sometimes formed in fine-grained sedimentary rocks during the drying and hardening of the sediment, but such joints generally do not extend outside the layer in which they are developed. Shrinkage joints are also formed in some igneous rocks, especially lava sheets and trap dikes, during the cooling and solidification of the molten rock.

Talus, *TAT lus*, is an accumulation of rock fragments heaped against the base of a cliff, or covering a slope below it, and composed of material detached from the face of the cliff. A talus may consist of earth, sand, gravel, or large rock fragments, depending upon the material of which the cliff is formed and upon the mode of weathering. In the British Isles, taluses are more commonly known as *screes*.

OUTLINE OF EARTH HISTORY

Periods and Epochs		Important Changes in the Earth	Changes in Living Things	Years Ago (Beginning)
Quaternary Period	Recent Epoch 10,000-25,000 yrs.			
Tertiary Period	Pleistocene, or Ice Age 1,000,000 yrs.	Ice Age glaciers melted and climates began to grow warm. The modern Great Lakes appeared, and land that had been covered by glaciers began to rise. Glaciers covered large parts of North America and Europe several times. Shores sank, but the Sierra Nevada and other mountains were uplifted again.	Man began to live in almost all parts of the world, cutting down forests, hunting, domesticating animals, and developing agriculture.	10,000 to 25,000
	Pliocene Epoch 11,000,000 yrs.	Mountains continued to rise, especially in the western parts of North and South America. Great volcanic eruptions continued. Climates grew cooler.	Human beings reached Europe and North America. Mammoths, woolly rhinos, and many other large animals lived in various parts of the world.	1,000,000
	Miocene Epoch 16,000,000 yrs.	The early Sierra Nevada and the Rocky Mountains were built. Great eruptions began to form the Cascades and lava plains of the West. Climates still were mild and rather uniform.	Elephants, camels, horses, and other mammals spread from continent to continent and became more like modern kinds.	12,000,000
CENOZOIC ERA	Oligocene Epoch 7,000,000 yrs.	Lands were low, with mild climates. Volcanoes erupted in the region of the Rockies and on the Great Plains. Alps and Himalayas began to rise.	Elephants of primitive types came to North America. Apes appeared in Asia and Africa. Redwoods lived in Colorado and other regions where they do not live now.	28,000,000
	Eocene Epoch 15,000,000 yrs.	Early mountains were worn down, piling clay and coarse sediment in basins. Climates were mild. Seas did not overflow much of the land.	The modern groups of mammals became dominant. Most of the early, primitive groups disappeared.	35,000,000
	Paleocene Epoch 10,000,000 yrs.	Mountains still were high and became higher. They were worn down rapidly. Climates varied greatly in different parts of the world.	Modern types of mammals, including horses, rhinos, and elephants, first appeared.	50,000,000
			Mammals, characterized by hair and warm blood, first became common. Most of them were small, stupid, and rather clumsy.	60,000,000
Laramide Revolution				
Land became high in many parts of the world. The earliest Rockies appeared where lakes and swamps had been.				
MESOZOIC ERA	Cretaceous Period 70,000,000 yrs.	The last great seas spread over North America and other continents. Lands became low, with great swamps. Climates were mild and uniform.	Flowering plants spread rapidly. Dinosaurs with horns and armor became common, but died out at the end of the period.	130,000,000
	Jurassic Period 40,000,000 yrs.	Lands were low, with large swamps. Shallow seas covered much of Europe and narrow basins in western North America. Climates became warmer and more moist.	Huge dinosaurs lived in western swamps. Reptiles of many kinds swam in the sea or even flew. The first birds appeared in Europe.	170,000,000
	Triassic Period 30,000,000 yrs.	Continents still were high, with many deserts. Late in this period, volcanoes and lava flows erupted in eastern North America.	Dinosaurs became common, but not large. Trees related to pines became common. They grew in thick forests in the West.	200,000,000

Great mountain ranges formed in North America, Europe, and Asia.				
Appalachian Revolution				
PALEOZOIC ERA	Permian Period 30,000,000 yrs.	Lands became higher and higher. Many swamps were drained and deserts developed. Extensive glaciers occurred, chiefly in the Southern Hemisphere.	Many swamp plants and several groups of animals died out. Reptiles became common and developed into many kinds.	230,000,000
	Carboniferous Period 60,000,000 yrs.	Seas spread and withdrew many times. Much land was low. Thick coal beds formed in great swamps in North America and Europe.	Forests of spore-bearing plants flourished. Reptiles developed and insects became both large and common.	290,000,000
	Devonian Period 40,000,000 yrs.	Shallow seas still spread onto most continents. Thick deposits formed by streams developed in parts of Europe, and large deltas formed in eastern North America.	The first forests grew in swamps. Fishes were common both in seas and in fresh water. Amphibians developed.	330,000,000
	Silurian Period 30,000,000 yrs.	Seas spread again and again over the low lands. Late in the period, mountains formed in northwestern Europe and many other parts of the world.	Land plants appeared. Sea scorpions became common and large. Great numbers of shelled animals lived in the sea.	360,000,000
	Ordovician Period 60,000,000 yrs.	Seas covered two thirds of North America. Lands became low. Deltas formed in what now are New York and Pennsylvania.	Marine animals were abundant. Fishlike creatures first appeared.	420,000,000
	Cambrian Period 80,000,000 yrs.	Seas spread across North America three times. Lands were low and no mountains were formed.	Animals without backbones, many of them with shells, were common in the seas.	500,000,000
Mountain building was followed by a long period of erosion that leaves a major gap in earth history.				
PROTEROZOIC ERA	Keweenawan Period 250,000,000 yrs.	Lava flows in the Great Lakes region were covered by thick sandstones and shales. Rich copper deposits formed in the lava.	Life may have been abundant in the seas, but only a few simple plants, sponges, and wormlike creatures are known, and these imperfectly.	750,000,000
	Huronian Period 250,000,000 or more yrs.	Thick sediments, including important iron-bearing beds, were deposited in the Lake Superior region. A period of cold and glaciation occurred.		1,000,000,000 or more
Algonian Revolution				
Mountains formed again in Canada and granite was intruded. Erosion reduced the new mountains.				
ARCHEOZOIC ERA	Timiskaming Period 300,000,000 yrs.	Seas spread over parts of Canada, leaving beds of shale and limestone. Rivers deposited gravel and coarse mud in valleys.	Limy sea plants left a few fossils. No other living things are known.	1,300,000,000
	Laurentian Revolution			
	Mountain building in Canada was accompanied by the formation of great masses of granite. A long period of erosion followed.			
	Keewatin Period 800,000,000 yrs.	Seas covered part of North America, depositing iron ore and limestone. Lava and ash also erupted in Canada.	Limy sea plants, probably algae, left the only known fossils.	2,100,000,000
AZOIC ERA.	The earth's crust cooled and formed rocks.		No traces of life are known.	4,500,000,000

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smaller pieces. At the edge of each glacier, where the ice melts, this material is piled together in deposits called *moraines*.

Most mountain glaciers make their way into valleys. Here they scour the bottoms deeper and deeper and make the sides very steep. Ice also cuts back into the mountains themselves, turning them into sharp peaks which the Swiss call *horns*. There are many horn peaks among the Rockies and other mountains of the West.

Thousands of years ago, a series of very large glaciers spread across much of North America and Europe. They covered hills and such mountains as the Catskills; they spread hundreds of miles across level plains. These great ice sheets scraped hills until they became low ridges, filled valleys with ground-up rock of moraines, and spread other moraines across prairies and northwestern plains. The rich farm lands of Illinois and Iowa are mo-

raines left when ice sheets melted thousands of years ago.

Effects of Plants and Animals. We know that land plants send roots into cracks, breaking rocks to pieces. In the sea, however, certain plants and the simple animals called *corals* build hard, limy structures which form banks and reefs. In time they collect sand and turn into islands, like many in the South Seas. See CORAL.

Most geologists think that oil, or petroleum, has come from very tiny plants that lived in shallow seas. When they died, their remains were mixed with sand or mud that settled on the sea bottom. They formed greasy deposits whose plant material slowly turned into petroleum.

Sediment and New Rocks. What becomes of all the material which winds, rivers, and other things wear from rocks of the land?

The answer is that most of it settles, becoming sediment that forms new deposits of rock. Sand, for example, piles up in beds which slowly turn into sandstone. Mud grains make layers of clay, which harden into shale and

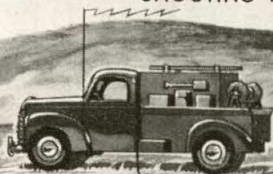
HOW GEOLOGISTS FIND PLACES TO DRILL FOR OIL

Oil is found in the pores of rocks in the earth. Salt water also is found in these rock pores. The oil is lighter than the water. Therefore it floats on the salt water and moves upward to a fold or dome in the rock, where it accumulates under a hard rock layer.

Where rocks are bent upward at the surface, geologists map the surface features to find locations for drilling. But where no hard rocks are exposed, the underlying domes are discovered by means of seismographic instruments, as shown here.

SHOOTING TRUCK

RECORDING TRUCK



Shot hole

Sound detectors

The operator of the shooting truck sets off a dynamite charge in the shot hole. The explosion causes a tiny earthquake. The shock waves, or vibrations, of this earthquake travel down through the earth until they reach a layer of hard rock. Then they are reflected back to the surface.

The recording truck picks up the reflected vibrations by means of sound detectors, which carry the waves to the seismograph. The seismograph records the time it took the waves to travel from the shot hole down to hard rock and back up to the surface. From this record, the depth of the hard rock layer can be determined. Several explosions, set off at different places, enable the geologist to make a map of the rock layer. The trucks are often miles apart, and communicate by telephone or radio.

OIL IN THE PORES OF THE ROCK

Anticline

Vibrations given off by dynamite

Reflected vibrations

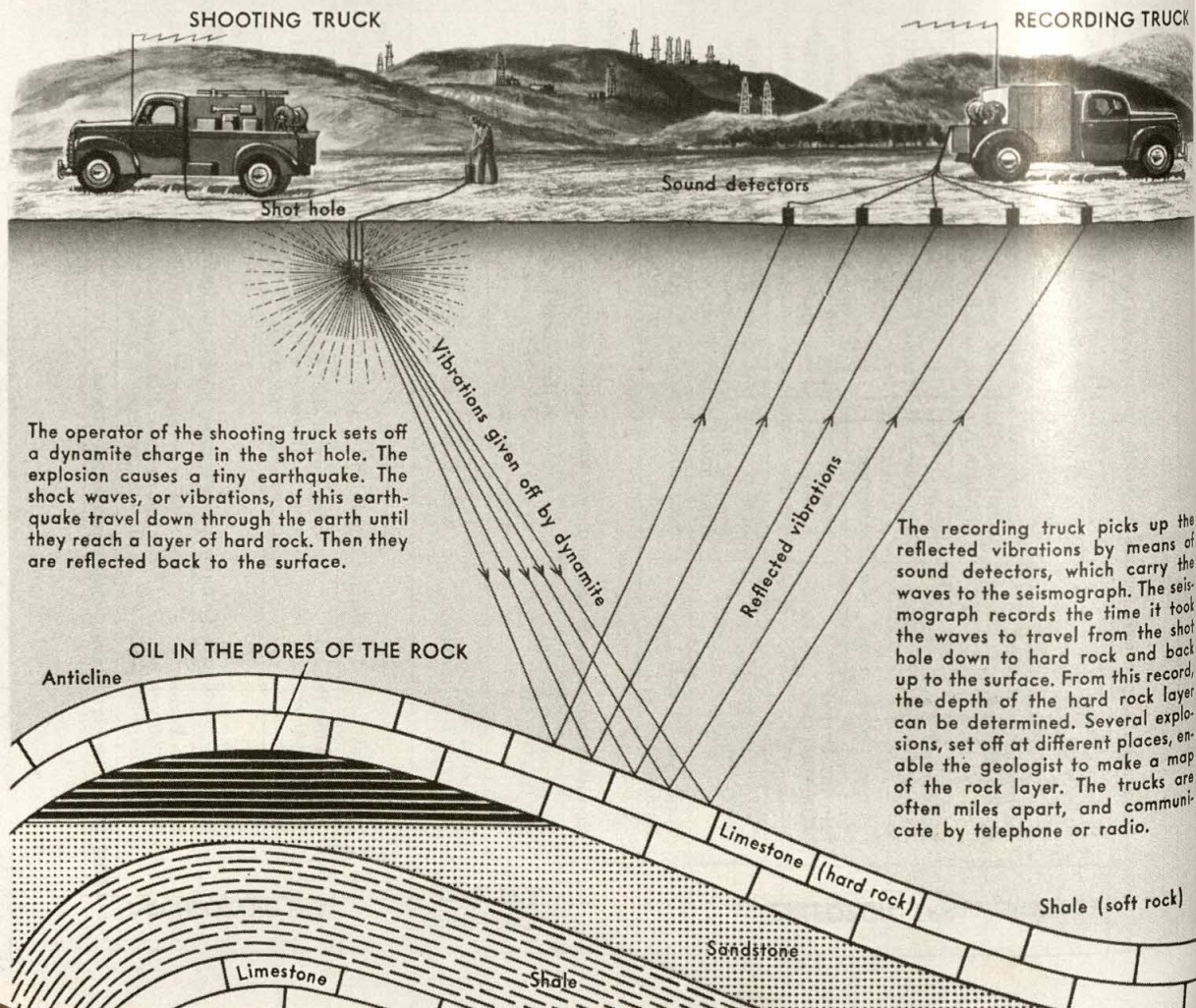
Limestone (hard rock)

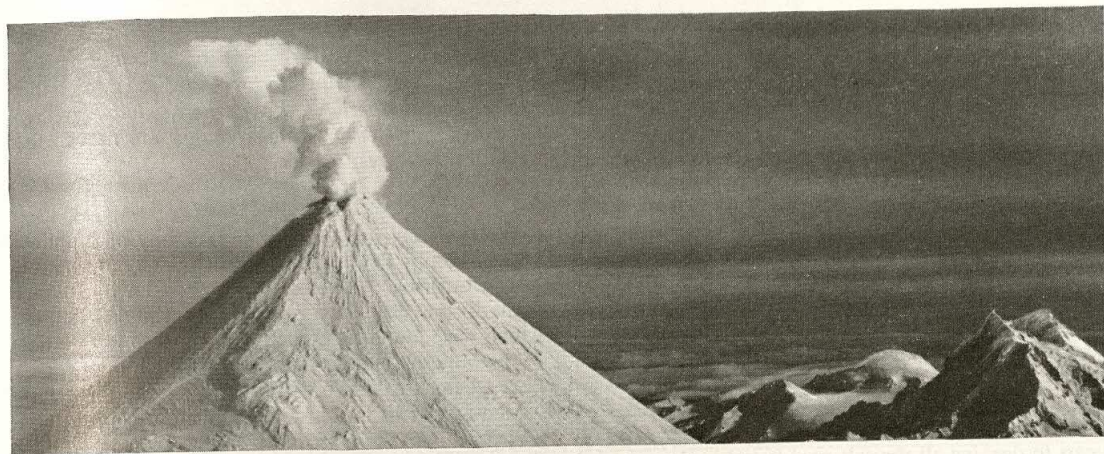
Shale (soft rock)

Sandstone

Limestone

Shale





A Plume of Steam Floats from the Top of the Largest Volcano in the Aleutian Islands.

may even be squeezed until they become slate. Gravel banks form conglomerate rock.

An Outline of Earth History

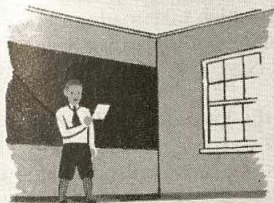
Sediment has been settling for ages. The oldest rocks known in the world began as sandy mud. In many places such deposits form thick layers, with the oldest beds at the bottom and the youngest at the top. When many such layers are fitted together, they give us a general outline of earth history.

That outline can be filled in, sometimes with surprising detail. Marks on beds, for example, tell of storms that raged long ago, while crumpled beds or great faults mean that mountains were built. Old lavas are records

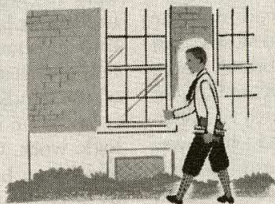
of eruptions, hardened moraines show that glaciers melted, and coal beds are evidence of swamps. Fossils, such as petrified shells, show that seas once covered many places which now are high, dry land. Fossils also help the geologists to classify rock formations, since each division of earth history had its own animals and plants which lived at no other time. Their remains in a group of rocks prove that it formed during the time when those things were living.

Eras, Ages, and Epochs. Early geologists divided earth history into four ages, or periods. These seemed enough for a while — until people began to find out how old our planet is and how often its surface has changed. Those discoveries showed that there have been at least

Many common substances found in buildings were discovered by geologists.



Plaster on walls contains the mineral gypsum.

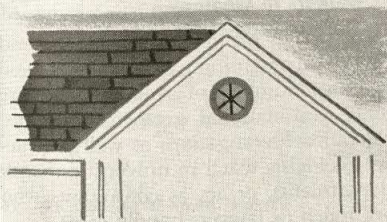


Concrete Foundations are made of limestone and shale.

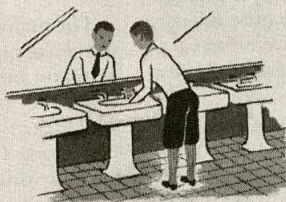


Glass is made from sand, the best deposits of which were discovered by geologists.

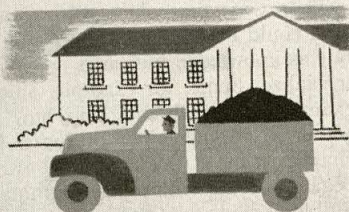
CONTRIBUTIONS OF GEOLOGISTS TO HOMES AND SCHOOLS



Roof Shingles contain asphalt and other minerals.



Plumbing Equipment is made from lead, iron, clay, and copper.



Fuels such as oil and coal heat our buildings.

GEOLOGY

fifteen periods, some of which can be divided into epochs. Periods themselves are grouped into eras, which were separated by times of mountain-building and other great changes.

Ages of the Earth. There was a time when the earth was supposed to be less than 6,000 years old. Thick series of beds proved that figure was too small, and scientists undertook to work out a better estimate.

Different men tried various methods of finding the age of the earth, with different results. A British physicist tried to determine how long the earth would take to cool if it started out as a molten ball. He got a figure of 20,000,000 to 40,000,000 years, but an American geologist decided upon 24,000,000 years. Another British scientist announced that it had taken 97,600,000 years to dissolve all the salt now found in the seas and oceans. He left out some things, however, so that later workers changed his figures to 112,600,000 and then to 330,000,000 or more. A geologist decided that sedimentary rocks had been forming for at least one billion years, and perhaps much more.

After about 1920, physicists and astronomers began to re-examine the problem. Most of them agreed that our earth and the rest of the solar system might be less than 4,500,000,000 years old, but surely were not much older. Our Outline of Earth History uses this figure of about 4,500,000,000 years.

Determining the Age of Rocks. In telling how old rocks are, geologists use the word *age* in two different ways. They may, for example, say that a formation is of Cambrian or Pliocene age, meaning that it formed during Cambrian or Pliocene times.

Since about 1920, however, more and more geologists have given the age of formations in actual years. This can be done because certain rocks contain radioactive substances, such as uranium. They shoot off tiny particles, and keep turning themselves into lead at a rate which never changes. Uranium does this so slowly that only half of it will be changed after five billion years.

No one has found a rock five billion years old, for that seems to be a longer time than the earth has been in existence. Rocks have been discovered, however, which contain so much lead and so little uranium that their age has been estimated at 1,850,000,000 and 2,200,000,000 years. A formation in Wyoming is 1,450,000,000 years old, while many rocks have been dated at less than a billion years. At least one deposit is known to have formed only 15,500,000 years ago.

Divisions of Geology

There was a time when geology was so simple that one man could become an authority on the entire science. But as knowledge increased, geologists were forced to specialize. Some, for example, studied fossils. Others examined minerals or found how they were put together in various kinds of rocks. Many investigated changes at the earth's surface. More and more geologists began to study volcanoes, earthquakes, and glaciers. Still later came scientists who combined physics, chemistry, and even astronomy with their studies of the earth.

Each new branch of geology got its own name, which generally was a long one. The study of fossils, for example, became *paleontology*. The study of rocks was

called *petrography*. Geologists who traced changes at the earth's surface called their branch *physiography*, while those who described forms of the land named their specialty *geomorphology*. *Volcanology*, *glaciology*, *sedimentology*, *geophysics*, and *geochemistry* are names that explain themselves.

Uses of Geology

We now rely upon geology every day of our lives. Do you doubt that? Then look at your home or your school building. The walls are covered with plaster, made in part from two rocks, gypsum and limestone, which were found by geologists. Concrete foundations of the building contain cement, for which other geologists located deposits of impure limestone and shale.

Geologic work found deposits of iron, copper, clay, and other materials needed to make pipes, plumbing fixtures, wash basins, and tiles for walls or floors. If the roof is covered with composition shingles, you may be sure that a geologist investigated rock for the granules that cover the shingles and give them their color. Of course, geologists located oil wells which provided asphalt for those shingles, as well as oil and gasoline for trucks which hauled material for the building.

This is one example. There are hundreds of others. Suppose a town gets its water from deep wells. A geologist whose specialty is ground water decides where the wells should be drilled and how deep they must go to reach a water-bearing formation. He also will predict what the water will be like and how much can be pumped from a single well.

But many cities get their water from lakes or from reservoirs made by building dams. Geologists decide where such dams can be built and tell how fast reservoirs will fill with mud carried to them by streams. Other geologic studies are made to plan the tunnels, or aqueducts, which often carry the water many miles from reservoirs to the city. Geologic planning also is needed for larger tunnels which take roads and railways through mountains or under wide streams. Several tunnels of this sort connect New York City with land west of the Hudson River.

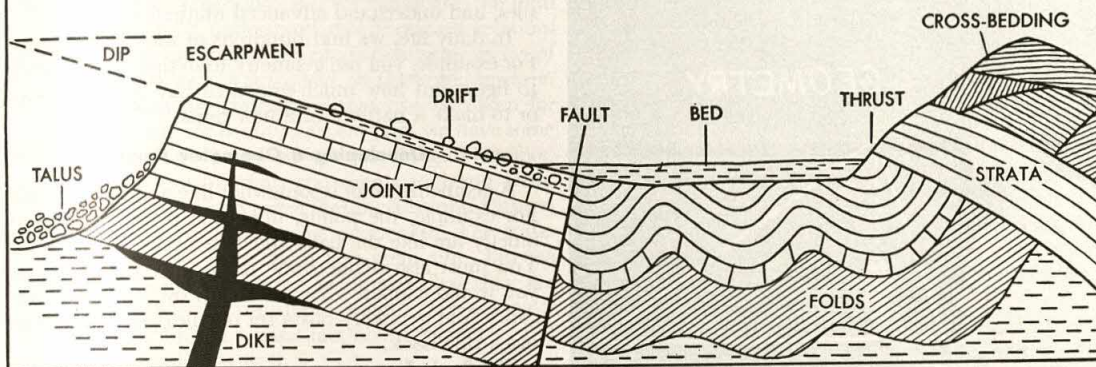
We have mentioned the location of oil wells as geologic work. Oil is found in special beds or formations, which can be recognized by tiny fossils and sometimes by mineral grains. Many geologists spend their time studying such things with microscopes, to trace the oil-bearing beds. Others use physical apparatus to locate rock folds and other structures underground. Such information helps determine where wells should be drilled. See PETROLEUM (How Men Find Petroleum).

Careers in Geology

The many uses of geology mean that trained men and women are needed by oil and mining companies, as well as many others. Large numbers of geologists also are employed by state and national geological surveys, which carry on detailed investigations as well as practical work. Other geologists teach in universities, work for city water departments, or act as consultants who do scientific work much as lawyers handle cases.

The Education of a Geologist begins with college courses—first in general geology and then in such special subjects as paleontology, mineralogy, and perhaps petrography. This generally is followed by one

TERMS USED IN GEOLOGY



to three or even four years of graduate study at a university. During this time the young geologist studies some special division of his science, as well as others that are related to it. He also writes at least one report, or thesis, on an investigation which he himself has made. During the summer he is likely to work for a company or survey, getting experience. Finally he—or she—takes examinations and secures an advanced degree. If graduate work has lasted one or two years, the degree probably will be Master of Science. Three or more years of graduate study earn a Ph.D. degree, which more and more geologists are securing.

CARROLL LANE FENTON

Related Articles. See the EARTH AND ITS RESOURCES section of the READING AND STUDY GUIDE for a detailed list of references relating to Geology. See also the biographies of Geologists listed in the BIOGRAPHY section of the GUIDE. See also the following articles:

Dinosaur	Geography	Petrology
Earth	Geological Survey	Prehistoric
Earthquake	Geomorphology	Animal
Erosion	Geophysics	Prehistoric Man
Floods and	Glacier	Prospecting
Flood Control	Ice Age	(picture)
Fossil	Mineral	Radiogeology
Geochemistry	Mountain	Rock
		Volcano

Outline

- I. How the Earth Began
 - A. The Nebular Theory
 - B. The Planetesimal Hypothesis
 - C. Other Explanations
- II. How the Earth Has Changed
 - A. James Hutton and Sir Charles Lyell
 - B. Volcanoes and Lava Flows
 - C. Molten Rock Underground
 - D. Movement of Sea and Land
 - E. Rocks Are Remade
- III. Erosion and Deposition
 - A. Weathering Destroys Rock
 - B. Work of the Wind
 - C. Running Water Destroys
 - D. Water in the Ground
 - E. Seas Destroy and Build
 - F. Glaciers Change the Land
 - G. Effects of Plants and Animals
 - H. Sediment and New Rocks
- IV. An Outline of Earth History
 - A. Eras, Ages, and Epochs
 - B. Ages of the Earth
 - C. Determining the Age of Rocks
- V. Divisions of Geology
- VI. Uses of Geology
- VII. Careers in Geology

Questions

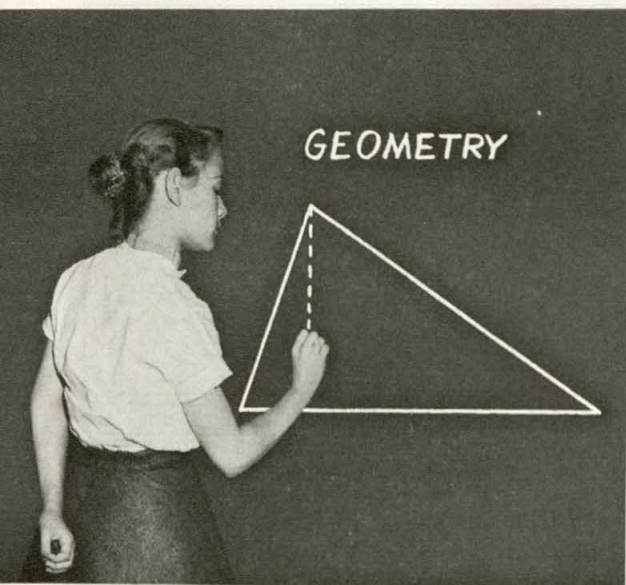
- About how old is the earth?
 What are some of the changes that have taken place in the earth since it was formed?
 Who first explained how canyons and gorges are formed?
 What is granite and how is it made?
 What is the meaning of each of the following in geology: (a) fault? (b) gneiss? (c) schist?
 How is the earth changed by frost? By wind?
 What is the difference between an old and a young river?
 How are caves formed? What causes hot springs?
 How does the sea destroy land? Build it up?
 How do scientists think petroleum was first formed?
 How is geology used in modern industry?
 What is the planetesimal hypothesis?
 How long ago did the Pliocene Epoch begin?

Books to Read

- FENTON, CARROLL L. *Earth's Adventures*. Day, 1942. With MILDRED A. FENTON: *Rocks and Their Stories*. Doubleday, 1951. *The Fossil Book: A Record of Prehistoric Life*. 1958.
 GALLANT, ROY A. *Exploring Under the Earth: The Story of Geology and Geophysics*. Garden City, 1960.
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 MOORE, PATRICK A. *The Earth, Our Home*. Abelard-Schuman, 1957. A history of the earth for the layman.
 REED, WILLIAM M. *The Earth for Sam*. Rev. ed. Harcourt, 1960.
 RICHARDS, HORACE G. *The Story of Earth Science*. Lip-pincott, 1959. A broad survey of geology for the amateur collector.
 SCHNEIDER, HERMAN and NINA. *Rocks, Rivers and the Changing Earth: A First Book About Geology*. W. R. Scott, 1952.
 SEVREY, O. IRENE. *The First Book of the Earth*. Watts, 1958.
 WYCKOFF, JEROME. *The Story of Geology: Our Changing Earth Through the Ages*. Golden Press, 1960.

GEOMETRIC STYLE is a term used to describe Greek art from about 900 B.C. to 700 B.C. Greek pottery of that period is decorated with simple geometric patterns arranged in an orderly manner. Even when figures and scenes appear, they are stylized and form part of the strict design. Other early peoples also used geometric decoration. The style can be found among the Kwakiutl Indians in the Pacific Northwest and the Pueblo Indians of New Mexico and Arizona. Many artists of today have adopted an abstract geometric style.

PETER SELZ



Illinois Education Assn.

GEOMETRY, *jee AHM uh trih*, is an important branch of mathematics. The study of geometry consists of finding many interesting and unusual facts about *points*, *lines*, and *planes*. It also includes finding the *lengths*, *areas*, and *volumes* of *geometric figures*, or figures of various shapes.

The name *geometry* comes from Greek words that mean *earth* and *to measure*. Originally, it dealt with the measurement of land. The ancient Egyptians used geometry to determine the size of their fields, and to find the boundaries of their farms after the yearly floods of the Nile River washed away or covered old landmarks. Surveying, a branch of geometry, became well developed thousands of years ago.

In geometry, we start by assuming a group of facts to be true. We tell clearly what we are going to mean by certain words. Then we prove the truth of hundreds of further statements. We discover new ideas, and show old ideas to be true by the careful use of the rules of logic (see *LOGIC*).

The Importance of Geometry

Geometry began as a practical study, and still has thousands of everyday uses. It is important as a school subject because it shows students how to develop ideas by logical reasoning, rather than by observation, description, and measurement. Geometry is practical and already arranged in logical order. But, perhaps more important, geometry is so simple and easy to picture that almost anyone can understand it. We can reason our way ahead, step by step.

We use geometry whenever we ask questions about the size, shape, volume, or position of anything. Automobile designers use it when they figure out how to make pistons fit engine cylinders, and how to make the engines fit the car bodies. Engineers and architects use geometric drawings in the plans of buildings and bridges. Highway builders need geometry to plan roads.

Every navigator of a sailboat, airplane, or spaceship must know geometry, because the principles of navigation are based on this study. The armed forces re-

quire officers and many enlisted men to know geometry so they can guide their vessels, aim their guns and missiles, and understand advanced mathematics.

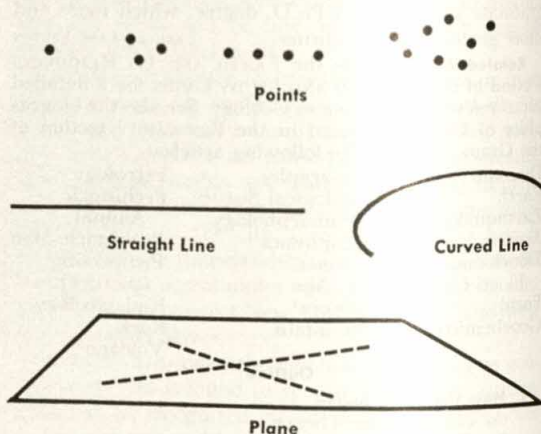
In daily life, we find hundreds of uses for geometry. For example, you use geometry to design a closet shelf, to figure out how much gravel to buy for a roadway, or to make a pattern for a new dress.

Developing a Geometric Proof

A geometric proof is somewhat like an athletic game. For example, the points, lines, and planes used in geometry are like the balls and bats needed in baseball. You must also define some terms, just as in baseball you would explain what you mean by "out" or "home run." And geometry has a set of rules, just as baseball has a rule book.

The Basic Elements of plane geometry are the point, the line, and the plane. *Plane geometry* is the first kind of geometry studied in school. It deals with figures on a plane, or flat surface. This and other kinds of geometry are discussed in the section of this article called *Kinds of Geometry*.

In geometry, we consider that points, lines, and planes are perfect. But the pictures we draw of mathematical figures are only approximate. For example, in geometry, a point has a position in space, but no size at all. A line has length, but no width. A plane has



length and width, but no thickness. Of course, we cannot draw figures such as these exactly. We can only come close to them, perhaps correct to the nearest tenth or thousandth of an inch.

Definitions. We must carefully define the terms used in geometry if we want to base our reasoning on them. For example, we cannot prove that a certain figure is a parallelogram unless we define what we mean by the term *parallelogram*.

We could define a parallelogram as a *quadrilateral* whose *opposite sides are parallel*. This definition begins by ruling out everything except a closed figure of four sides (a quadrilateral). Then it rules out all four-sided figures whose opposite sides are not parallel. The definition now defines a parallelogram and nothing else. Here is another example of a geometric definition that tells what we mean by the word *parallel*.

Two straight lines in the same plane which do not meet no matter how far extended are said to be parallel.

Some terms in geometry are not defined. For example, mathematicians do not make a formal definition of the term *congruence*. But we can define the term informally to help understand this important relationship. We may say that *if you can put one figure on top of another so that they match throughout, the figures are congruent*.

Assumptions are statements that can be taken for granted. We cannot begin to reason until we have some statements on which to base our reasoning. Therefore, we must agree on certain statements to begin with. Almost everyone would agree that the assumptions used in plane geometry seem to be reasonable. The statements that follow from them also seem true. But we can use assumptions without being sure that they are true. In fact, we can use them without even asking if they are true. This is a basic fact about geometry, and about all reasoning as well.

For example, a mathematician may assume that we have four dimensions instead of the three with which we are familiar—length, width, and thickness. He can then proceed to build up a perfectly good geometry of four dimensions. The study of four-dimensional geometry might seem rather difficult because we cannot easily draw, or even imagine, the diagrams.

An incorrect assumption may lead to incorrect conclusions. Before the time of Christopher Columbus, most navigators assumed that the earth was flat. This led them to sail only near home, so they would not fall off the edge of the earth. Columbus assumed that the earth was round. He then concluded that he could reach India just as well by traveling west as by the familiar eastern route. He was right.

Geometry is based on assumptions that we accept without proof. These assumptions are often divided into two sets—axioms and postulates.

Axioms are general assumptions that govern not only geometry, but also arithmetic, algebra, and other fields of mathematics. Here are six axioms:

A-1 Any quantity is equal to itself.

A-2 Quantities equal to the same quantity are equal to each other.

A-3 The whole of a quantity equals the sum of its parts.

A-4 The halves of a quantity are equal.

A-5 If equal quantities are added to equal quantities, the sums are equal.

A-6 If equal quantities are multiplied by equal quantities, the products are equal.

Postulates are assumptions that are not general, but are used particularly in geometry. Here are 11 postulates:

P-1 One and only one straight line may be drawn through any two distinct points.

P-2 Two distinct straight lines cannot have more than one point in common.

P-3 A line can be extended to any desired length.

P-4 The shortest path between any two points is a straight line joining these points.

P-5 All radii or all diameters of the same circle are equal.

P-6 All right angles are congruent.

P-7 A figure may be moved without changing its size or shape.

P-8 Through a given point not on a straight line, one, and only one, straight line may be drawn that is parallel to the given line.

P-9 Corresponding parts of congruent figures are equal.

P-10 Two triangles are congruent if two sides and the included angle of one are equal respectively to two sides and the included angle of the other.

P-11 Two triangles are congruent if three sides of one are equal to three sides of the other.

Advanced mathematicians do not like to accept as a postulate any statement that they can prove by other postulates. But, in elementary geometry, we sometimes accept without proof a statement that we can prove. For example, postulates P-10 and P-11 can be proved by using other postulates.

Theorems are formal statements that are to be proved. A theorem has two parts, the hypothesis and the conclusion. The *hypothesis* states what we take for granted or assume. The *conclusion* states what we want to prove as a result. Here is a theorem:

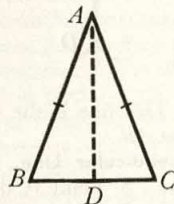
If two sides of a quadrilateral are equal and parallel, the figure is a parallelogram.

The “if” part is the hypothesis. The last five words are the conclusion.

We may prove a theorem in several related steps. We justify each step by a definition, an axiom, a postulate, a previously proven theorem, by the use of what was given in the hypothesis, or by the way in which a helping construction line has been drawn. Here is a theorem and the steps involved in proving it:

In an isosceles triangle, the angles opposite the equal sides are equal.

Given: triangle ABC with $AB = AC$ (an isosceles triangle is one with two equal sides).



To prove: angle C = angle B .

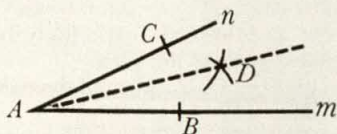
First, draw line AD cutting angle BAC into two equal parts, and meeting line BC at point D . From the first axiom (A-1), we know that AD equals AD . We know that $AB = AC$, because that was given in the hypothesis of this theorem. We also know that angle DAB = angle DAC , because axiom A-4 says that halves of a quantity are equal. Now we see that two sides and the included angle of triangle DAB equal respectively the two sides and the included angle of triangle DAC . Therefore, the triangles are congruent by postulate P-10. Now we can see that angle C = angle B because they are corresponding parts of congruent triangles (P-9).

Constructions

It is useful to be able to construct certain figures accurately. For example, everyone should know how to bisect an angle, or cut it into two equal parts, and how to bisect a line into halves. It is also handy to be able to draw a perpendicular line to another line from a particular point. For these constructions, we need a ruler and a compass.

GEOMETRY

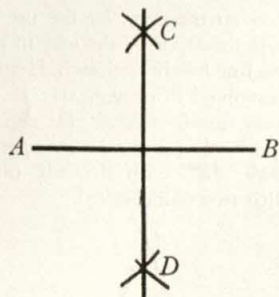
Bisecting an Angle. Suppose we want to bisect the angle formed by lines m and n that meet at point A .



Put the point of the compass at A , and draw an arc cutting m and n at two points, called B and C . With B and C as centers, draw equal arcs that intersect at D . Draw line AD . Now angle DAC and angle DAB are each equal to half of angle BAC .

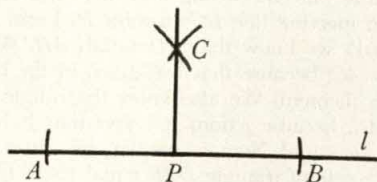
We can prove this construction. Since AD in one triangle equals AD in the other triangle, we have congruent triangles. This is because three sides of one triangle are equal to three sides of the other (P-11). Now, notice that angle DAC and angle DAB have corresponding positions in both triangles. So these two angles are equal, because corresponding parts of congruent figures are equal (P-9).

Bisecting a Line. To bisect a line AB , draw equal arcs with A and B as centers that cut each other at C



and D . Draw CD . This line is the perpendicular bisector of the segment AB .

Drawing a Perpendicular Line. To draw a line perpendicular to line l at point P , draw arcs using P as a center and cutting line l at A and B . Then, with

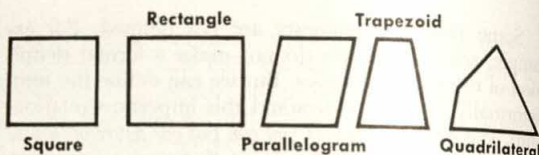


A and B as centers, swing arcs longer than PA , cutting each other at C . Draw PC . This line is perpendicular to line l at P .

Geometric Figures

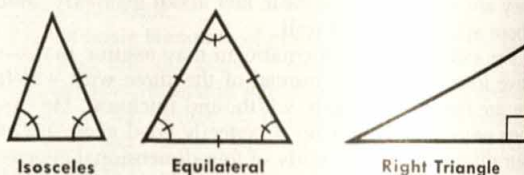
There are many kinds of geometric figures that have names. The ones found most commonly when studying elementary geometry include quadrilaterals and triangles.

Quadrilaterals are closed figures with four straight sides. Squares, rectangles, parallelograms, and trapezoids are all quadrilaterals.



A *trapezoid* is a quadrilateral with two parallel sides. If two pairs of sides are parallel, we have a *parallelogram*. If all the angles are right angles, we have a *rectangle*. In a *square*, all the angles are right angles and all the sides are equal. Thus, a square is a kind of rectangle, which is a kind of parallelogram, which is a kind of trapezoid, which is a kind of quadrilateral.

Triangles are closed three-sided figures. There are many special kinds of triangles.



An *isosceles* triangle has two sides of the same length. It also has two equal angles. An *equilateral* triangle has all sides equal, and all angles equal. A *right* triangle has one angle of 90° . If one angle of a triangle is larger than 90° , it is an *obtuse* triangle. If all the angles are less than 90° , it is an *acute* triangle.

Kinds of Geometry

Plane Geometry deals with points, lines, polygons, and circles on a flat surface. In plane geometry, given a proper set of facts, we can prove such things as the following:

1. Two triangles have the same shape.
2. Two triangles have the same size.
3. Two angles are equal.
4. Two lines are equal.
5. Two polygons have the same size and shape.
6. Two lines are parallel.

We can learn ways of finding the sizes of angles, lines, and areas. We can also discover many interesting and useful ideas about circles.

Solid Geometry includes the study of points, lines, and planes in space. Solid figures have three dimensions, such as length, width, and height. We can find these dimensions for cones, cubes, cylinders, prisms, pyramids, rectangular boxes, and spheres. *Spherical* geometry is an interesting branch of solid geometry. It deals with figures on the surface of a sphere. It is especially useful in navigation, because the earth is shaped approximately like a sphere.

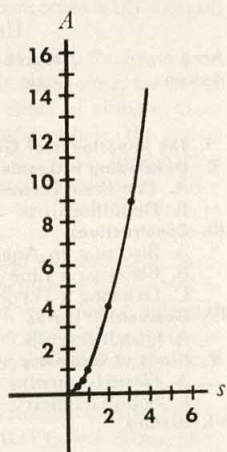
Analytic Geometry enables us to describe many kinds of lines, curves, and surfaces by means of mathematical equations. Also, a person may make an exact picture of algebraic equations, and visualize or solve problems graphically. In fact, making graphs is the first step in understanding analytic geometry.

In analytic geometry, you can discover many interesting things about the parabola and other curves. This branch of geometry starts with the study of a group of curves called *conic sections*, because they are formed by passing a plane through a cone. Conic sections include curved lines, circles, parabolas, ellipses, and hyperbolas.

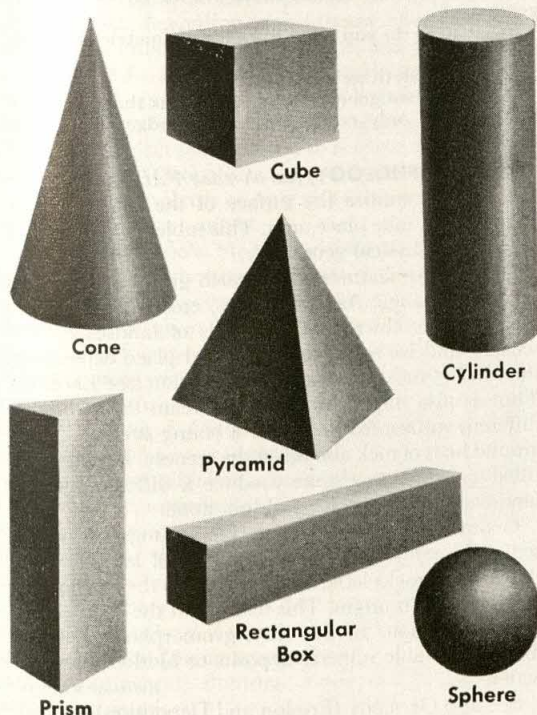
Many higher curves may be studied, including spirals and leaf-shaped figures. Analytic geometry uses trigonometry and also plays an important part in calculus (see TRIGONOMETRY; CALCULUS).

Suppose you want to make a graph showing the relationship between the area of a square and one of its sides. The formula $A=s^2$ (the area equals the square of one side) expresses the relationship between the variable A and the side s . Draw two intersecting lines on which distances will represent the numbers: s on the horizontal line and A on the vertical line. Then make a table:

1. $s=0$	$A=0$
2. $s=\frac{1}{4}$	$A=\frac{1}{16}$
3. $s=\frac{1}{2}$	$A=\frac{1}{4}$
4. $s=1$	$A=1$
5. $s=2$	$A=4$
6. $s=3$	$A=9$



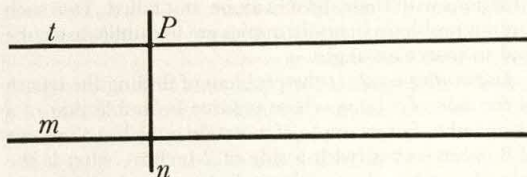
Now you can find the point on the graph where $s=1$ and $A=1$, and another point for each pair of numbers in the table. When you connect these points, you have part of a curve called a *parabola*. From this, you can read the length of side for any area. For example, for an area of 2 units, the side would be about 1.4 units.



Non-Euclidean Geometry. Mathematicians have developed many geometries, each based on a different set of postulates or assumptions. About 300 B.C., the Greek mathematician Euclid formally stated the first fundamental assumptions in the geometry that describes the world as we usually see it. We call the system that resulted from Euclid's assumptions Euclidean geometry. See EUCLID OF ALEXANDRIA.

Euclidean geometry serves us well for most practical purposes. Curiosity about one of Euclid's postulates has led to two other geometric systems, both of which have become useful in the study of physics.

Postulate 8 stated that *through a given point not on a straight line, one, and only one, straight line may be drawn that is parallel to the given line*. You can see that there are two possible ways that this postulate can be changed. One variation is to say that there may be more than one line parallel to the given line. That is, in the illustration below there may be other lines than t that go through point P and are parallel to line m .



Another variation is to say that all lines through point P will meet line m , if we extend them far enough. Thus, line t will meet line m .

The mathematician does not concern himself with the questions, "Do these lines *really* meet?" He is equally interested in all possibilities. The two geometries based on these variations in Euclid's postulate are called non-Euclidean because changing the parallel postulate leads to many interesting results different from ordinary plane or Euclidean geometry.

In Euclidean geometry, we assume that lines t and m do not intersect. If we assume the lines always intersect, we call the resulting system *elliptic geometry*. If we assume that two or more lines can be drawn through the given point P and not intersect line m , the resulting system of geometry is called *hyperbolic geometry*. All three geometric systems have practical applications in science.

History

The use of geometry dates back before the dawn of history. Excavations of ancient cities show that land and buildings were carefully laid out. Egyptian architects and engineers designed and built huge temples and pyramids. Babylonian astronomers measured circles and made careful observations of the planets and stars. We still measure angles the way the Babylonians did thousands of years ago when we divide a full circle into 360 degrees, a degree into 60 minutes, and a minute into 60 seconds.

Historians believe that Egyptian and Babylonian geometry dealt only with practical problems. It was probably not until about 600 B.C. that Greek mathematicians started to develop the reasoning and logic

GEOMETRY

needed to prove the truth of mathematical statements. Thales of Miletus (c. 640-546 B.C.) began the study of lines and triangles. Pythagoras (c. 580-500 B.C.) developed the interesting and useful theorem that bears his name (see **PYTHAGOREAN THEOREM**).

Plato (427?-347 B.C.) developed the method of forming a proof. Aristotle (384-322 B.C.) noted the difference between axioms and postulates. About 300 B.C., Euclid organized geometry as a single logical system. His book, *The Elements*, remains a basic work in geometry and mathematics. It contains 13 books, of which 5 concern plane geometry and 3 deal with solid geometry. The rest give geometric explanations of mathematics now studied in algebra. Archimedes (287-212 B.C.) found volumes and areas by methods similar to those now used in calculus. These men and other Greek mathematicians developed elementary geometry to a high degree.

Whenever possible, the Greeks based their proofs on constructions made by compasses and unmarked straightedges. They tried hard to make certain constructions with these devices alone, but failed. Two such famous problems in mathematics are to duplicate a cube and to trisect an angle.

Duplicating a cube is the problem of finding the length of the side of a cube whose volume is double that of a given cube. For example, if a certain cube has a volume of 8 cubic inches (with a side of 2 inches), what is the side of a cube whose volume is 16 cubic inches?

Trisecting an angle is the problem of taking any angle and dividing it into three equal parts.

Present-day mathematicians have proved that these constructions cannot be made with straightedges and compasses, using circles and straight lines alone. However, the Greeks had many solutions to these problems that involved the use of higher curves, such as parabolas and hyperbolas. The Greeks solved many very difficult problems, some of which are now part of algebra, by means of geometric diagrams with elementary and higher curves and surfaces.

The next great advance in geometry was made by the French mathematician René Descartes. In 1637, he published the first book on analytic geometry. He showed a relationship between algebraic equations and geometric figures. This opened new lines of thinking in mathematics.

Shortly after 1800, Karl Friedrich Gauss and Georg Friedrich Riemann of Germany, János Bolyai of Hungary, and Nikolai Lobachevsky of Russia investigated what would happen if Euclid's assumption about parallel lines were changed. This created new kinds of geometry, which gave Albert Einstein one of the starting points for his theory of relativity (see **RELATIVITY**). It also led to the mathematics which enabled later scientists to develop theories of atomic structure that led to the release of atomic energy.

HOLMES BOYNTON

Related Articles in **WORLD BOOK** include:

ALLIED FIELDS

Algebra
Calculus
Map
Mathematics

Measurement
Mechanical Drawing
Navigation

Surveying
Topology
Trigonometry

FAMOUS GEOMETRICIANS

Archimedes	Euler, Leonhard	Pythagoras
Descartes, René	Gauss, Karl F.	Thales
Euclid of Alexandria	Ptolemy	

GEOMETRIC FIGURES AND CONSTRUCTION

Angle	Diameter	Polygon	Skew Line
Axis	Ellipse	Prism	Solid
Circle	Hexagon	Pyramid	Sphere
Cone	Hexahedron	Quadrilateral	Square
Cube	Line	Rectangle	Tangent
Curve	Parabola	Rhomboid	Tetrahedron
Cylinder	Pentagon	Rhombus	Triangle

UNCLASSIFIED

Area	Degree	Pythagorean Theorem
Axiom	Logic	Volume

Outline

- I. The Importance of Geometry
- II. Developing a Geometric Proof
 - A. The Basic Elements
 - B. Definitions
 - C. Assumptions
 - D. Theorems
- III. Constructions
 - A. Bisecting an Angle
 - B. Bisecting a Line
 - C. Drawing a Perpendicular Line
- IV. Geometric Figures
 - A. Quadrilaterals
 - B. Triangles
- V. Kinds of Geometry
 - A. Plane Geometry
 - C. Analytic Geometry
 - B. Solid Geometry
 - D. Non-Euclidean Geometry
- VI. History

Questions

- In what ways does geometry help us in everyday life?
- What are the elements of geometry?
- How do assumptions govern geometry?
- What are the two parts of a theorem?
- What kinds of things can be proved in plane geometry?
- On what questions do Euclidean and non-Euclidean geometries differ?
- What important contributions did the Greeks make to geometry?
- What tools do you need to make geometric constructions?
- How is analytic geometry useful?
- What are two geometric constructions that cannot be solved using only compasses, straightedges, lines, and circles?

GEOMORPHOLOGY, *JEE oh mawr FAHL oh juh*, is the science that studies the surface of the earth and the changes that take place on it. This subject is a branch of geology or physical geography.

The surface features of the earth go through regular cycles of change. As time passes, erosion wears down rocks and produces various kinds of landscape. The scenery that we see at any time and place depends on the kind of rock and the kind of erosion (see **EROSION**). Time is also important. An old stream flows through different surface features than a young stream. Underground beds of rock also affect the scenery. For example, tilted layers of sandstone produce a different type of landscape than flat layers of limestone.

Geomorphology puts these factors together to describe the *topography*, or appearance, of land areas by the way the rocks look. It also classifies the topography according to its origin. This tells about the geologic history of a region. In this way, geomorphology aids in finding valuable mineral deposits or hidden sources of water.

RICHARD M. PEARL

See also **GEOLOGY** (Erosion and Deposition).

GEOPHYSICS is the science of the earth and its atmosphere. The geophysics of the main body of the earth includes such branches as *seismology*, the study of earthquakes; *geology*, the study of the earth's crust and the changes it has undergone; and *geodesy*, the study of the shape and size of the earth and the measurement of distances between points. *Glaciology* concerns the properties and motion of glaciers, and *oceanography* is concerned with tides, currents, and ocean beds. In *geomagnetism* and *geolectricity*, scientists study the earth's magnetic field and the electrical currents that flow around the earth. *Gravimetry* is concerned with the pull of gravity.

The branches of geophysics that study the lower part of the earth's atmosphere include *meteorology*, the study of weather, and *climatology*, the study of climate. Geophysicists investigate the upper atmosphere, the region that starts about 10 miles above the earth, by studying sunlight, auroras, meteor trails, and radio waves. They also use balloons, rockets, and artificial satellites in upper-atmosphere investigations.

Geophysics is an important and expanding science. Mineral prospectors use the principles of geophysics to locate deposits of oil, uranium, and other valuable minerals. The study of the upper atmosphere helps in weather forecasting and space travel. The most extensive geophysical investigations ever conducted were carried out by scientists from 66 nations during the International Geophysical Year (IGY), held from July, 1957, to December, 1958.

K. B. FENTON

Related Articles in WORLD BOOK include:

Climate	Glacier	Meteorology
Earth	International Geophysical	Ocean
Geodesy	Year	Space Travel
Geology	Magnet and Magnetism	Weather

GEOPOLITICS, *JEE oh PAHL uh ticks*, attempts to explain world political developments in terms of geographic space. According to this theory, the world contains only a limited amount of space, and all countries are involved in a never-ending struggle among themselves to get enough to survive. Geopolitics tries to describe the relationship between space and foreign policy. A Swedish scholar, Rudolf Kjellen, was the first to use this term. Geopolitics has now gone out of fashion because of its emphasis on only one factor in explaining the power of great nations.

In the early 1900's, Sir Halford Mackinder, an English geographer, advanced a theory of geopolitics that emphasized the importance in world politics of nations that controlled great land areas. He called the great land mass of Europe, Asia, and Africa, the *World Island*. All other areas were only satellites. The central land of Europe and Asia, including Germany and Russia, was the *Heartland*. Control of the Heartland was supposed to be the key to world power.

German geopoliticians, especially Karl Haushofer (1869-1946), combined Mackinder's theory with some of their own theories and developed geopolitics into a pseudo science. They argued that modern advances in transportation and communication had opened great spaces of land and increased the power of the countries controlling that land. Oceanic countries would have to grant *lebensraum* (living space) to the newer, more dynamic continental countries. Adolf Hitler put these ideas into practice.

WILLIAM T. R. FOX

GEORGE



George I

GEORGE was the name of six kings of Great Britain. The first two were more German than English, but George V and VI rank among the most truly English of all British monarchs.

George I (1660-1727) came to the British throne when Queen Anne died in 1714. He was great-grandson of King James I of England. Born and brought up in Germany, George had succeeded his father as elector of Hanover in 1698.

George was a shy, obstinate, and lazy man who neither aroused loyalty nor concerned himself with English affairs. He knew that he had become king of England through a series of coincidences. But he did keep in close touch with his ministers, of whom the most famous was Sir Robert Walpole. The two most dramatic events of George's reign were the Jacobite rebellion of 1715, which attempted to restore the Stuarts as rulers of Great Britain, and the bursting of the "South Sea Bubble," a great financial scandal, in 1720. See **WALPOLE** (Sir Robert).

George II (1683-1760) succeeded his father, George I, in 1727. Born in Hanover, he was almost as German as his father. A brave man, and ambitious for military prestige, he was the last British ruler to lead troops on the battlefield. This increased his popularity enormously.

Although George II was a stubborn and rather stupid man, he usually took advice, especially if he was persuaded that he had really originated the idea. During the first part of his reign, he depended chiefly upon Walpole and upon his wife, Queen Caroline, who took an active part in politics. Later, his chief ministers, Henry Pelham and the elder William Pitt, helped him greatly (see **PITT**).

Great changes marked the reign of George II. Triumphs, especially during the Seven Years' War (1756-1763), laid the foundations of empire in India and Canada, and increased British prestige throughout the European world. The failure of the second Jacobite rebellion in 1745 proved the stability of the Hanoverian regime. Agricultural and industrial advances changed the political and social structure of the country.

George III (1738-1820) governed Great Britain during one of the most critical periods in the country's history. He succeeded his grandfather, George II, in 1760. During the following 60 years, several revolutions modified every aspect of British life. The French Revolution threatened Britain's existence. The Amer-

George II

Culver





George III

Culver



George IV

Culver



George V

Brown Bros.



George VI

Karsh, Ottawa

ican Revolution cost Britain its American colonies. And the continuing Industrial Revolution created a new society and more than doubled the British population during his reign. New territories were acquired in place of those in America, however. In 1800, the Act of Union brought Ireland into the kingdom, which then became known as the kingdom of Great Britain and Ireland.

George III took a far greater part in governing England than George I or George II. Hardworking and proud of being English, he tried to destroy the power of the Whig aristocrats, who had held control for many years under Walpole, Pelham, and the elder Pitt. George chose his ministers, especially Lord North and the younger William Pitt, with this in mind (see NORTH, LORD). Unfortunately, George was emotionally unbalanced, and became hopelessly insane in 1811. His wife was Charlotte of Mecklenburg-Strelitz.

George IV (1762-1830), the son of George III, became king in 1820. He had served as regent for his father from 1811 to 1820. He lacked his father's ambition to govern, and, with his brothers, he lowered the prestige of the royal family. His private life was scandalous, and he had no share in the important reforms of his brief reign. Among these were the reform of criminal law and of the police, the freeing of trade, and the grant of increased toleration to both Protestant dissenters from the Church of England and Roman Catholics. Nevertheless, George IV was a man of taste, and he commissioned some of England's most beautiful buildings.

George V (1865-1936), the second son of Edward VII, became heir to the throne when his older brother died in 1892. Meanwhile, he had been trained for the navy, and became a vice-admiral in 1903. He was married in 1893 to Princess Victoria Mary of Teck. They had six children. See MARY (Mary of Teck).

George toured the world after his father became king in 1901. When he succeeded his father in 1910, his subjects knew little about him. But he and his queen gained immediate and lasting popularity by their courage and devotion during the greatest event of the reign, World War I. This popularity was increased by George's conscientious attention to his duties. A Silver Jubilee lasting three months celebrated 25 years of his reign in 1935. George V was succeeded by his oldest son, Edward VIII.

George VI (1895-1952) was the second son of George V. He became king in December, 1936, after his elder brother, Edward VIII, abdicated. George VI reigned

during one of the most troubled periods in the history of Great Britain. He was a popular monarch because of his untiring devotion to royal duty.

George studied under private tutors, then went to Osborne and Dartmouth naval schools. He became a midshipman on H.M.S. *Collingwood* in 1915, and served in World War I. He was with the Grand Fleet in the Battle of Jutland. In 1918, he joined the Royal Flying Corps and became a wing commander. He studied at Cambridge University in 1919. In 1920, he was created Duke of York. In 1923, George married Lady Elizabeth Bowes-Lyon (1900-), a daughter of the Scottish Earl of Strathmore and Kinghorne. They had two daughters, Elizabeth and Margaret Rose.

King George and Queen Elizabeth made tours of Canada and South Africa, and became the first British monarchs to visit the United States. During World War II, the royal family endeared itself to the people by sharing dangers and hardships with them. Under the Labour governments of the years following the war, socialistic measures included socialized medicine, and nationalization of the Bank of England and the coal and steel industries.

India became an independent dominion in 1947, and the words *Emperor of India* were dropped from the King's title. George was succeeded by his elder daughter, Elizabeth II (see ELIZABETH II).

CHARLES F. MULLETT

GEORGE is the name of two kings of Greece.

George I (1845-1913) replaced Otto, the first king of Greece, in 1863. Otto had been overthrown. George was a Danish prince, and the ancestor of every later Greek king. During his reign of about 50 years, Greece expanded by adding such territories as Thessaly and Crete. A revolutionist assassinated George in 1913. His oldest son, Constantine, succeeded him as king (see CONSTANTINE I).

George II (1890-1947), the grandson of George I, became king in 1922. His father, Constantine, had been deposed after the unsuccessful Greek invasion of Turkey. George was dethroned in 1923, and the Greeks established a republic. He was recalled to the throne in 1935, and a year later permitted one of his generals to establish a dictatorship. The German invasion of Greece in 1941 drove George and his government into exile. When he returned in 1946, a civil war broke out between communists and those who supported the king. George died during this war.

R. V. BURKS

See also GREECE (History); PAUL I.

GEORGE, DAVID LLOYD. See LLOYD GEORGE, DAVID.

GEORGE, HENRY (1839-1897), an American social reformer, originated the *single tax*. The basic principle of this plan was that land is a free gift of nature; that all men have an equal right to use the land; and that it is unfair for a few to acquire great wealth by holding land which increases in value. George proposed to make this "unearned increment" (increase in value) the source of all taxation (see **SINGLE TAX**).

George was born in Philadelphia, and began supporting himself at the age of 14. He sailed to Australia, hunted gold in British Columbia, and later became a printer, a reporter, and a newspaper editor. His theories were first published in 1871 in a pamphlet called *Our Land and Land Policy*. He stated his theory more completely in *Progress and Poverty* (1879). In 1886, he was nearly elected mayor of New York.

H. W. SPIEGEL

GEORGE, JAMES ZACHARIAH (1826-1897), was an American statesman, jurist, and soldier. He represented Mississippi in the United States Senate from 1881 until his death. He was the only Democrat to have an important share in framing the Sherman Antitrust Act of 1890 (see **TRUST** [Trust Legislation]). George served as chief justice of the Mississippi Supreme Court. He was called the state's "Great Commoner" (see **GREAT COMMONER**). He fought in the Mexican War and in the Civil War. George was born in Monroe County, Georgia.

ARTHUR A. EKIRCH, JR.

GEORGE, LAKE. See **LAKE GEORGE**.

GEORGE, LAKE. See **AUSTRALIA** (Rivers and Lakes).

GEORGE, SAINT, is the patron saint of England. The facts of his life are hidden in legends, and little is known of him. He was probably born in Lydia of Cappadocian parents. He became a soldier and rose to high rank under Diocletian, but his open profession of Christianity

GEORGE PEABODY COLLEGE

led to his arrest. He was tortured and put to death at Nicomedia (A.D. 303) on April 23, which is his feast day.

Saint George was highly venerated by the crusaders, and in 1350 was made patron saint of England. The red cross of Saint George on a white background was long worn as a badge by English soldiers, and still appears in the British Union Flag. The well-known legend of Saint George and the dragon may have arisen from attaching to the saint the story of Perseus in Greek mythology. According to the story, Saint George killed the dragon to which the king's daughter was being sacrificed by slaying it with his magic sword called *Ascalon* (sometimes spelled *Askelon*). Perseus slew the sea monster that threatened Andromeda in much the same way.

Saint George is also the patron saint of Portugal. In other European countries, he is protector of many societies. A nonpolitical association in the United States is known as *Sons of Saint George*.

FULTON J. SHEEN

See also **DRAGON** (picture); **FLAG** (color picture, *Historic Flags of the World*); **GARTER**, **ORDER OF THE**.

GEORGE, WALTER F. See **GEORGIA** (Famous Georgians).

GEORGE, WILLIAM R. See **GEORGE JUNIOR REPUBLIC**.

GEORGE CROSS. See **DECORATIONS AND MEDALS** (British Commonwealth).

GEORGE JUNIOR REPUBLIC is a village near Freeville, N.Y. The inhabitants include boys and girls between the ages of 13 and 19. They receive full responsibility as citizens when they become 15 years old. The town has its own constitution and runs its own affairs by means of town meetings.

The boys and girls go to school and have jobs within the community. They are paid for their work in special money which they use to buy what they need. The school provides a junior and senior high-school course. Boys may choose training in carpentry, printing, farming, plumbing, or aeronautics. Girls may study office work, home economics, or the household arts.

Boys and girls come to the George Junior Republic from all parts of the United States. The republic was founded by William R. George (1866-1936) in 1895. Similar republics have been set up for children in other states.

DONALD T. URQUHART

GEORGE PEABODY COLLEGE FOR TEACHERS is a coeducational privately endowed school at Nashville, Tenn. The college includes the Peabody Demonstration School. Both offer a complete educational program from nursery school through graduate school.

George Peabody College is a southern regional education center for the training of elementary, secondary, and college teachers. George Peabody also trains school and college administrators, librarians, and other specialists. The college provides special training for teachers of handicapped and gifted children.

The college was founded in 1875 with funds provided by George Peabody, a philanthropist. In 1867, he founded the Peabody Educational Fund. George Peabody College offered the first advanced professional degrees in education in the South. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

HENRY H. HILL

See also **PEABODY, GEORGE**; **PEABODY EDUCATION FUND**.

St. George Slays a Dragon in this Picture by Raphael.

National Gallery of Art, Washington, D.C., Mellon Collection



GEORGE PEPPERDINE COLLEGE

GEORGE PEPPERDINE COLLEGE. See PEPPERDINE COLLEGE.

GEORGE WASHINGTON BIRTHPLACE NATIONAL MONUMENT in Virginia, contains the site of the house where George Washington was born. The Memorial Mansion, not a replica of the original, was erected on the site of the birthplace. The 393.68-acre monument was established in 1930.

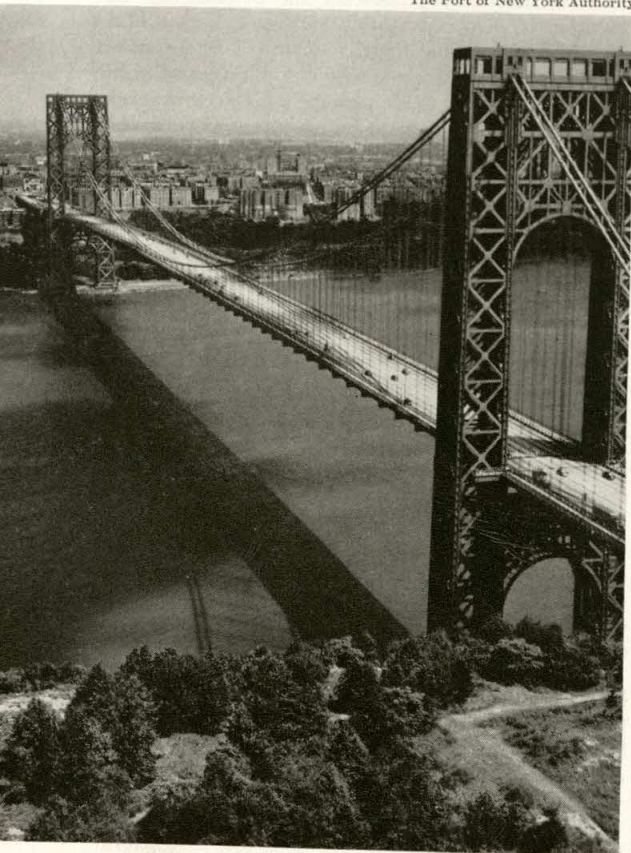
GEORGE WASHINGTON BRIDGE over the Hudson River connects New York City at 178th Street with Fort Lee, N.J. Its span is 3,500 feet long. Four huge cables hold up this suspension bridge. Each cable is 36 inches in diameter and consists of 26,474 steel wires, woven tightly together. The cables holding up the central portion contain 107,000 miles of wire. Two towers that rise 650 feet above the water support the cables. The floor of the bridge lies 253 feet above the water. It is 120 feet wide and contains an eight-lane road. The bridge was started in 1927 and completed in 1931. It cost about \$60,000,000.

A six-lane second deck beneath the original roadway was scheduled for completion in 1962. The new deck provides changes in approaches to the bridge as well as new outlets to major interstate highways. The estimated cost of the second-deck project is about \$183,000,000.

LEE K. JAFFE

George Washington Bridge spans the Hudson River near its mouth and links New York City with Fort Lee, N.J.

The Port of New York Authority



GEORGE WASHINGTON CARVER NATIONAL MONUMENT, in southwestern Missouri, marks the birthplace of this famous scientist. He was born of slave parents, in a cabin on the farm of Moses Carver. The 210-acre monument was established in 1951.

GEORGE WASHINGTON OF CHILE. See SAN MARTÍN, JOSÉ DE.

GEORGE WASHINGTON OF SOUTH AMERICA. See BOLÍVAR, SIMÓN.

GEORGE WASHINGTON UNIVERSITY is a coeducational liberal arts school in Washington, D.C. It has colleges of arts and sciences; schools of law, medicine, engineering, pharmacy, education and government. There is also an AROTC, a summer session, and a junior college, called Columbian College. The university conducts research projects sponsored by the federal government and by private business and industry. In 1950 the library acquired the 70,000-volume library of the Carnegie Endowment for International Peace. The location of the university provides many opportunities for using the many facilities of the nation's capital, such as government departments, museums, art galleries, and libraries. George Washington University was founded in 1821. For enrollment, see UNIVERSITIES AND COLLEGES (table).

MYRNA SEDGWICK

GEORGE WILLIAMS COLLEGE is a privately controlled coeducational school in Chicago. Its basic goal is to provide professional education for Christian leadership, primarily for Young Men's Christian Associations. Undergraduate courses lead to the B.S. degree in Health and Physical Education, and in Group Work. The school also offers two-year courses at the graduate level, leading to the M.S. degree. George Williams College was founded in 1890. For enrollment, see UNIVERSITIES AND COLLEGES (table).

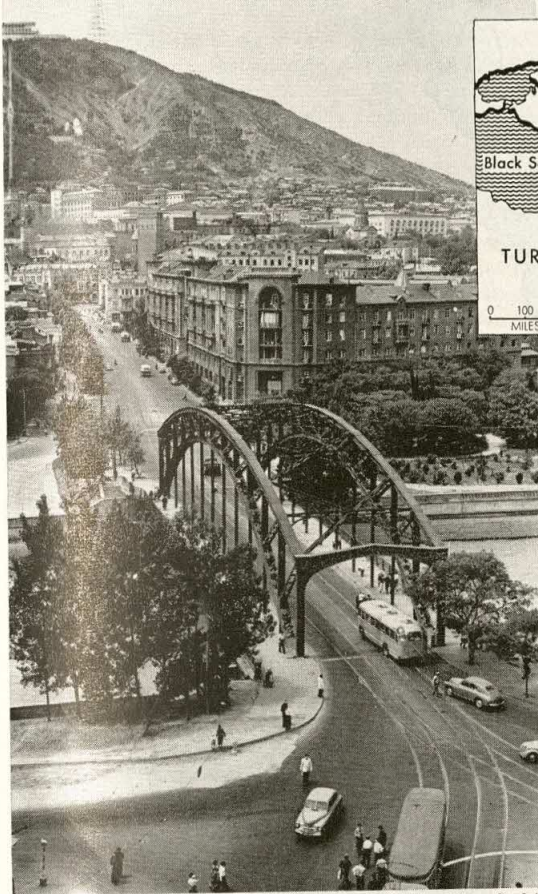
GEORGETOWN (pop. 73,509; alt. 10 ft.) is the capital and chief city of British Guiana. It lies on the east bank of the Demerara River, facing the Atlantic Ocean. For location, see BRITISH GUIANA (map). Georgetown is built on low land. A sea wall and an extensive system of dykes protect the city from ocean tides. Georgetown provides the main outlet for the exports of British Guiana.

ARTHUR P. WHITAKER

GEORGETOWN COLLEGE is a coeducational liberal arts school at Georgetown, Ky. It is privately controlled, but its administration is closely connected with the Baptist Church in Kentucky. The college grants bachelor's degrees. Georgetown began as a classical school in 1787, and was chartered as a college in 1829. For enrollment, see UNIVERSITIES AND COLLEGES (table).

GEORGETOWN UNIVERSITY is a Roman Catholic university in Washington, D.C. It is conducted by the Fathers of the Society of Jesus. All the divisions of Georgetown except the College of Arts and Science admit women. The School of Nursing is for women only. The main campus lies in northwest Washington, once the colonial village of Georgetown. Other divisions of the university include schools of medicine, dentistry, and law; a graduate school; and the Institute of Languages and Linguistics. The School of Foreign Service, founded in 1919, was the first school in the United States to provide training for students interested in the diplomatic service or in overseas business. Georgetown was founded in 1789. For enrollment, see UNIVERSITIES AND COLLEGES (table).

ANNE D. McLAUGHLIN



Tass, Sovfoto

GEORGIA (pop. 4,049,000), often called the **GEORGIAN SOVIET SOCIALIST REPUBLIC**, is one of the 15 republics that make up the Soviet Union. It lies in the



The Republic of Georgia in the Soviet Union lies on the eastern coast of the Black Sea. The capital, Tiflis, far left, lines both banks of the Kura River in a broad, terraced valley.

extreme southwestern part of Russia, and covers 29,400 square miles. Georgia borders the republic of Russia on the north, the republic of Azerbaidzhan on the east, the republic of Armenia and Turkey on the south, and the Black Sea on the west. For location, see **RUSSIA** (color map).

The Caucasus Mountains, with the highest peaks in Europe, rise in northern Georgia. The Armenian Plateau and Lesser Caucasus Mountains make up the southern part of the republic. Two of every three Georgians farm for a living. They raise tea, citrus fruits, tobacco, and grapes in the warm, humid lowlands that stretch inland from the Black Sea. The republic has rich mineral resources, chiefly coal and manganese, and dense forests. Tiflis (also called Tbilisi), in eastern Georgia, is the capital of the republic (see **TIFLIS**). Batumi is the chief port on the Black Sea.

An independent regime, headed by moderate Socialists, was set up in Georgia in 1918. This government was overthrown by the invasion of the Red Army early in 1921, after the end of the Russian civil war. Georgia then became a so-called Soviet republic. Actually, it is a political division under the Communist dictatorship of Russia.

THEODORE SHABAD

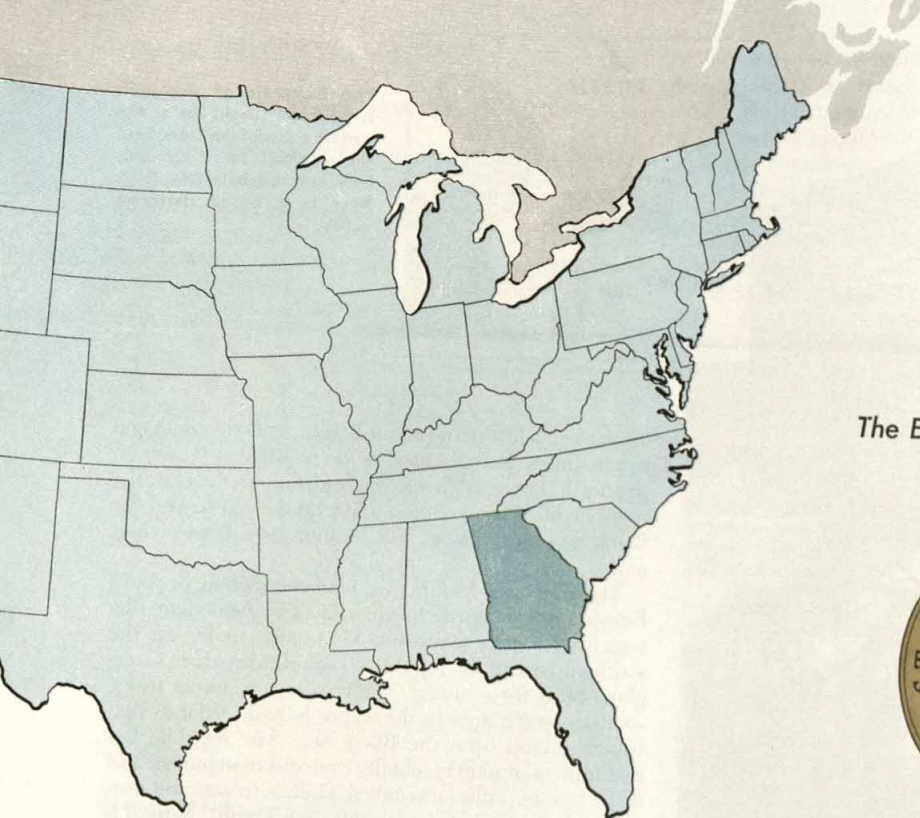
Georgetown University



Georgetown University's
White-Gravenor Building, left, contains many classrooms.

Old North Building Porch,
below, where Washington, Lafayette and Lincoln made speeches.





GEORGIA

The Empire State of the South



The State Seal

GEORGIA, *JAWR juh*, or *JAWR jih uh*, is the largest state east of the Mississippi river. It was the last founded and farthest south of the original 13 American colonies. James Oglethorpe brought the first settlers only 42 years before the Revolutionary War and named the colony for King George II of England. Georgia has the nickname **THE EMPIRE STATE OF THE SOUTH**, because of its size and industry. Atlanta is the capital and largest city.

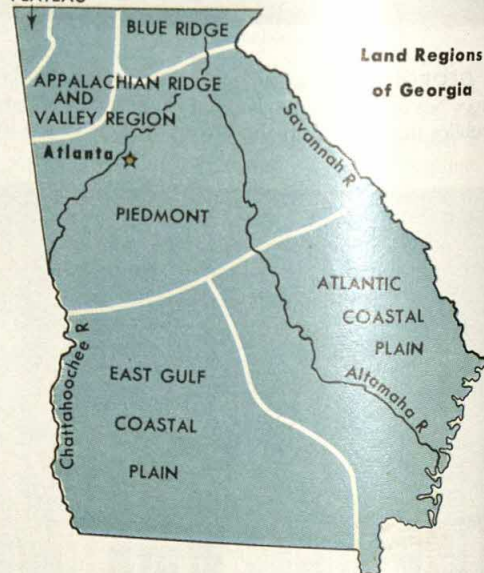
Country roads wind through fields of cotton, peanuts, and tobacco planted in the state's red soil. Southern Georgia is a mild, sunny land of flowering magnolias, moss-draped trees, roses, and poinsettias. The beauty of the state has inspired many stories and songs. The Suwannee River that begins near Waycross was made famous by Stephen Foster's song, "Old Folks at Home."

Georgia farmers were the first in the nation to grow cotton for use in industry. The state manufactures almost three fourths of the cord and fabrics used in automobile tires. Georgia leads the states in the production of broiler chickens, peanuts, and pimiento peppers. It ranks high in the growing of pecans, watermelons, and cotton. Georgia is sometimes also called **THE PEACH STATE** because it has long been a leading producer of peaches.

Forests cover about two thirds of Georgia. They supply about four fifths of the nation's turpentine and rosin. The pine trees that tower over much of Georgia led to the expression "tall as a Georgia pine."

Beautiful marble from northwest Georgia was used in building the Lincoln Memorial in Washington, D.C., and for the state capitols in Rhode Island, Minnesota, Kentucky, and Arkansas. Georgia produced the largest

APPALACHIAN PLATEAU



Land Regions of Georgia

block of marble ever quarried. This 76-ton block is part of the Buckingham Fountain in Chicago.

Many important events in history have taken place in Georgia. The University of Georgia, founded in 1785, was the first state-chartered university. Eli Whitney invented the cotton gin in 1793, while visiting near Savannah. Dr. Crawford W. Long, of Jefferson, discovered the use of ether as an anesthetic, and performed the first painless operation in 1842. Many hard-fought

battles of the Civil War raged on Georgia soil. In 1943, Georgia became the first state to give 18-year-olds the right to vote.

For Georgia's relationship to its neighboring states, see SOUTHERN STATES.

The Land and Its Resources

Location and Size. Georgia has an area of 58,876 square miles. The *Color Map* shows it is bounded on the north by Tennessee and North Carolina, on the east by South Carolina and the Atlantic Ocean, on the south by Florida, and on the west by Alabama.

Land Regions. Georgia has six land regions: (1) the Appalachian Plateau, (2) the Appalachian Ridge and Valley Region, (3) the Blue Ridge Mountains, (4) the Piedmont, (5) the Atlantic Coastal Plain, and (6) the East Gulf Coastal Plain.

The *Appalachian Plateau* occupies the northwestern corner of the state and extends into Alabama and Tennessee. This mountainous region ranges in height from 1,800 to 2,000 feet above sea level. Narrow valleys separate the wooded ridges. Thin, sandy soil makes this region the poorest farming area in Georgia.

The *Appalachian Ridge and Valley Region*, in northwestern Georgia, is divided into several broad, fertile valleys separated by long, parallel ridges. Pine and hardwood forests once covered these valleys. The rich soils now produce cotton, fruits, grains, and vegetables.

The *Blue Ridge Mountains* rise in the northeastern part of the state. Many of the peaks are from 2,000 to nearly 5,000 feet high. Hardwoods and pine trees blanket the slopes of these mountains. The rivers of this area provide much of the state's hydroelectric power.

The *Piedmont* covers nearly a third of the state in a

FACTS IN BRIEF

Capital: Atlanta (since 1868). *Earlier capitals*, Savannah (1733-1786); Augusta (1786-1795); Louisville (1796-1806); Milledgeville (1807-1868).

Government: *Congress*—U.S. Senators, 2; U.S. Representatives, 10. *Electoral votes*, 12. *State Legislature*—senators, 54; representatives, 205. *Voting Age*, 18 years. *Counties*, 159.

Area: 58,876 square miles (including 602 square miles of inland water), 21st in size among the states. *Greatest distance:* (north-south) 315 miles; (east-west) 250 miles. *Coast line*, 96 miles.

Elevation: *Highest*, Brasstown Bald, 4,784 feet above sea level; *lowest*, sea level along the coast.

Population: 3,943,116 (1960), 16th among the states. *Density*, 67 persons to the square mile. *Distribution*, urban, 55 per cent; rural, 45 per cent.

Chief Products: *Agriculture*, cattle, cotton, hogs, poultry, tobacco. *Manufacturing and Processing*, cottonseed oil, peanut oil, textile products, tung oil, wood products. *Fishing Industry*, shrimps. *Forest Industry*, lumber, pulpwood, rosin, turpentine. *Mining*, barite, bauxite, fuller's clays, stone, cement, sandstone gravel, iron ore.

Statehood: Jan. 2, 1788, the 4th state.

State Seal: The arch represents the state constitution. The three columns bear Georgia's motto. Georgia signed the Declaration of Independence in 1776. The seal has been in use since 1914.

State Flag: The blue band next to the flagstaff bears the state seal. The remainder of the flag is the Stars and Bars, the battle flag of the Confederate States of America. Adopted in 1956.

State Motto: Wisdom, Justice, and Moderation.

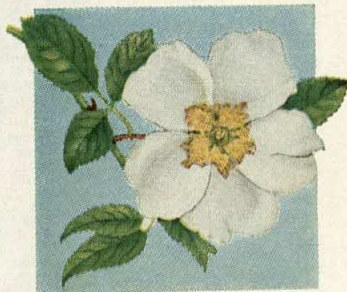
State Song: "Georgia." Words by Robert Loveman; music by Lollie Belle Wylie.



The State Flag



The State Bird
Brown Thrasher



The State Flower
Cherokee Rose



The State Tree
Live Oak

GEORGIA (Map Index)

Population

3,943,116 1960
3,444,578 1950
3,123,723 1940

Physical Features

Alapaha R. E 3
Alcoy Mtn. B 3
Allatoona Lake B 2
Altamaha R. E 4
Altamaha Sound E 5
Amicalola Falls B 2
Appalachian Mts. B 2
Banks Lake F 3
Bartlett's Ferry Dam D 1
Big Bald (Mtn.) E 4
Big Satilla Creek E 4
Black Jack Mtn. A 5
Blackshear Lake E 3
Blood Mtn. B 3
Blue Ridge (Mts.) B 3
Blue Ridge Dam B 2
Blue Ridge Lake B 2
Brasstown Bald (Mtn.) B 2
or Mt. Enotah (Highest Point in Georgia) B 3
Brier Creek C 5
Broad R. B 4
Buford Dam B 2
Burton Lake B 3
Canoochee R. D 5
Cave Springs Cave B 1
Chattahoochee R. E 3
Charlotte Reservoir A 3
Clark Hill Reservoir C 4
Coastal Plain E 4
Cohutta Mtn. B 2
Coosa R. B 1
Coosawatee R. B 2
Cowpens Mtn. B 2
Cumberland Isl. F 3
Dahlonega Plateau B 2
Doboy Sound E 5
Dougherty Plain E 1
Dowdell Knob (Mtn.) D 2
Dugdown Mtn. C 1
Etowah R. B 2
Fall Line Hills C 2
Flint R. E 2
Fort Frederica Nat. Mon. E 5
Fort Pulaski Nat. Mon. D 6
Goat Rock Dam D 1
Hurricane Creek E 4
Indian Grave Mtn. C 2
Jackson Lake C 3
Jekyll I. E 5
Jim Woodruff Reservoir F 2
Kennesaw Mtn. C 2
Kincaidonee R. E 2
Lake Harding D 1
Lake Sidney Lanier B 2
Lake Sinclair C 3
Langdale Dam D 2
Little Ocmulgee R. D 3
Little R. C 3
Little R. C 4
Little R. E 3
Little Satilla R. E 4
Little Tallapoosa R. C 1
Lookout Mtn. B 1
Louisville Plateau C 3
Mt. Enotah (see Brasstown Bald)
Muckalee Creek D 2
Mud Creek B 5
Nancy Creek A 5
Neel Gap (Pass) B 3
North Creek B 3
Notely Lake B 2
Oak Mtn. B 2
Ochlockonee R. F 2
Ocmulgee Nat. Mon. D 3
Ocmulgee R. D 3
Oconee R. D 4
Ogeechee R. D 5
Ophoree R. D 4
Okefenokee Swamp E 3
Okefenokee Swamp E 3
Ossabaw Isl. E 5
Ossabaw Sound E 5
Piedmont Plateau B 3
Pigeon Mtn. B 1
Pine Mtn. D 2
Providence Canyons D 2
Rabun Bald (Mtn.) B 3
Rabun Gap (Pass) C 3
Rock Eagle Mtn. C 3
St. Andrew Sound F 5
St. Catherine's Isl. E 5
St. Catherine's Sound E 5
St. Marys Entrance F 5
St. Marys R. F 5
St. Simons Isl. E 5
St. Simons Sound E 5
Salt Peter Cave B 2
Sapelo Isl. E 5
Sapelo Sound E 5
Satilla R. E 5
Savannah R. D 5
South R. B 5
Stone Mtn. C 2
Suwannee Mtn. B 2

Suwannee R. F 4
Tallulah Mtn. B 3
Taylor Ridge B 1
Tifton Upland E 3
Trail Ridge F 4
Tray Mtn. B 3
Tugalo R. B 3
Walker Mtn. B 3
Wassaw Sound E 6
Wilkesmoochee R. B 3
Yellow R. B 6

Counties

Appling, 13,246 E 4
Atkinson, 6,188 E 4
Bacon, 8,359 E 2
Baker, 4,543 E 2
Baldwin, 34,064 C 3
Banks, 6,497 B 3
Barrow, 14,485 B 3
Bartow, 28,267 B 2
Ben Hill, 13,633 E 3
Berrien, 12,038 E 3
Bibb, 141,249 D 4
Camden, 9,975 F 4
Brantley, 5,891 E 3
Brooks, 15,292 F 3
Bryan, 6,226 F 3
Bulloch, 24,263 D 5
Burke, 20,596 C 4
Butts, 8,976 C 3
Calhoun, 7,341 E 2
Camden, 9,975 F 4
Candler, 6,672 F 4
Carroll, 36,451 C 1
Catoosa, 21,101 B 1
Charlton, 5,313 F 4
Chatham, 188,299 E 5
Chattahoochee, 13,011 D 2
Chattahoochee, 19,954 B 2
Cherokee, 23,001 B 2
Clack, 15,363 F 3
Clay, 4,551 E 2
Clayton, 46,365 C 2
Cline, 6,545 F 4
Cobb, 114,174 C 2
Coffee, 21,953 E 4
Colquitt, 34,048 E 3
Columbia, 13,423 C 2
Cook, 11,822 C 2
Cort, 28,893 C 2
Crawford, 5,816 D 2
Crisp, 17,768 E 3
Dade, 6,666 B 1
Dawson, 3,590 B 2
Decatur, 25,203 E 2
DeKalb, 256,782 C 2
Dodge, 16,483 D 3
Doolittle, 12,474 D 1
Dougherty, 75,680 E 2
Douglas, 16,741 C 2
Early, 13,151 E 2
Echols, 1,876 F 4
Effingham, 10,144 D 5
Elbert, 17,835 B 4
Emanuel, 17,815 D 4
Evans, 6,952 D 1
Fannin, 13,620 C 2
Fayette, 8,199 C 2
Floyd, 69,130 B 1
Forsyth, 12,170 B 2
Franklin, 13,274 B 3
Fulton, 556,326 C 2
Gilmer, 8,922 C 1
Glynn, 2,672 C 4
Gordon, 19,228 B 2
Grady, 18,015 F 2
Greene, 11,192 C 3
Gwinnett, 43,541 C 2
Habersham, 18,116 B 3
Hall, 49,739 B 3
Hancock, 9,979 C 3
Haralson, 14,543 C 1
Harris, 11,167 D 2
Hart, 15,229 B 4
Heard, 5,333 C 1
Henry, 17,619 C 2
Houston, 39,154 D 3
Irwin, 9,211 E 3
Jackson, 18,499 B 3
Jasper, 6,135 E 3
Jeff Davis, 8,911 C 4
Jefferson, 17,468 C 4
Jenkins, 9,148 D 4
Johnson, 8,048 D 4
Jones, 8,468 D 3
Lamar, 10,240 C 2
Lanier, 5,097 C 3
Laurens, 32,313 E 4
Lee, 6,204 D 2
Liberty, 14,487 E 5
Lincoln, 5,906 C 4
Long, 3,874 E 5
Lowndes, 49,270 F 3
Lumpkin, 7,241 B 2
Macon, 13,170 D 2
Madison, 11,246 D 2
Marion, 5,477 D 2
Mc Duffie, 12,627 C 4
Mc Intosh, 6,364 E 5
Meriwether, 19,756 C 2
Miller, 6,908 E 2
Mitchell, 19,652 E 2
Monroe, 10,495 D 3
Montgomery, 6,284 D 4
Morgan, 10,280 C 3

Murray, 10,447 B 2
Muscogee, 158,623 D 2
Newton, 20,999 C 3
Oconee, 6,304 E 3
Oglethorpe, 7,925 C 3
Paulding, 13,101 C 2
Peach, 13,846 D 3
Pickens, 8,903 E 2
Pierce, 9,678 E 4
Pike, 7,138 C 2
Polk, 28,015 C 1
Pulaski, 8,204 D 3
Putnam, 7,798 C 1
Quitman, 2,432 C 1
Rabun, 7,456 B 3
Randolph, 11,078 E 2
Richmond, 135,601 C 4
Rockdale, 10,572 C 2
Schley, 3,256 D 2
Screven, 14,919 D 5
Seminole, 8,802 F 2
Spalding, 15,404 C 2
Stephens, 18,391 B 3
Stewart, 7,371 D 2
Sumter, 24,652 D 2
Talbot, 7,127 D 2
Taliaferro, 3,370 C 4
Tattall, 15,837 D 4
Taylor, 8,311 D 2
Terrell, 11,715 E 1
Terrell, 12,742 E 1
Thomas, 34,319 F 3
Tift, 23,487 E 3
Toombs, 16,837 D 4
Towns, 4,538 B 3
Trenton, 5,874 D 4
Turner, 47,189 D 3
Truman, 8,439 E 3
Twin, 9,935 D 3
Union, 6,510 B 2
Upson, 23,800 D 2
Walker, 45,264 B 1
Walton, 20,481 C 3
Ware, 34,219 E 4
Warren, 7,360 C 4
Washington, 18,903 C 4
Way, 12,982 E 4
Webster, 3,247 D 2
Wheeler, 5,342 D 4
White, 6,935 B 3
Whitfield, 42,109 B 2
Wilcox, 7,905 E 3
Wilkes, 10,961 C 4
Wilkinson, 9,250 D 3
Worth, 16,682 E 3

Cities

Abac, 500 E 3
Abbeville, 872 E 3
Acree, 125 E 3
Acworth, 2,359 A 4
Adairsville, 1,026 B 2
Adel, 4,321 D 4
Adrian, 568 D 4
Aid, 500 B 3
Ailey, 469 D 4
Airline, 200 B 3
Alamo, 822 D 4
Alapaha, 631 E 3
Albany, 55,890 E 2
Albany South, 1,200 E 2
Aldora, 535 C 2
Alexander, 150 C 5
Allenhurst, 200 E 5
Allentown, 450 D 5
Alma, 3,515 E 4
Almon, 300 C 3
Alpharetta, 1,349 A 5
Alston, 154 D 4
Altman, 100 D 5
Alto, 275 B 3
Alto Park, 500 B 1
Ambrose, 244 E 3
Americus, 13,472 D 2
Amity, 300 C 4
Amsterdam, 511 F 2
Andersonville, 263 D 2
Apalachee, 158 C 3
Appling, 250 C 4
Arabi, 303 E 3
Aragon, 1,023 B 1
Arcade, 108 B 3
Arcade, 1,500 E 5
Aryle, 225 E 4
Arlington, 1,462 E 4
Armuchee, 200 B 1
Ashburn, 3,291 E 3
Aska, 135 B 2
Athens, 31,355 C 3
Atlanta, 487,455 C 2
(*1,017,188) B 5
Attapulgus, 567 F 2
Auburn, 374 C 3
Augusta, 70,626 C 5
Austell, 1,867 B 3
Avalon, 194 B 3
Avans, 990 B 3
Avera, 197 C 4
Avondale Estates, 1,646 B 5
Axson, 320 E 4
Baconton, 564 E 4
Bainbridge, 12,714 F 2
Bairdstown, 200 C 3
Baldwin, 698 B 3
Ball Ground, 707 B 2
Banning, 150 C 2
Barnesville, 4,919 C 2
Barney, 165 E 3

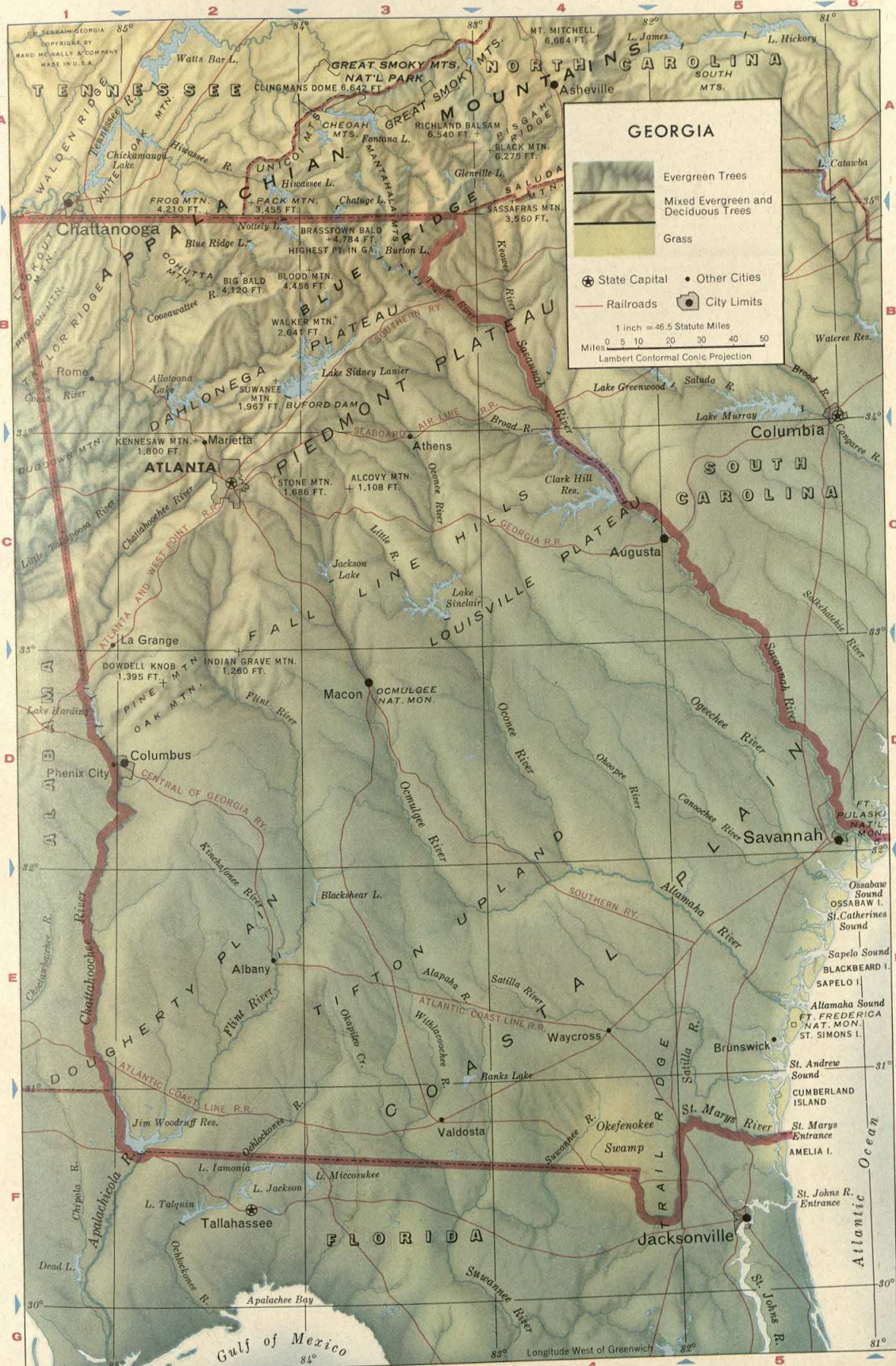
Barton Woods, 3,000 C 2
Bartow, 366 D 4
Barwick, 426 D 3
Baxley, 4,268 E 4
Baxter, 120 B 2
Bellevue, 300 D 5
Benevolence, 123 E 2
Benning Hills, 500 D 2
Benning Park, 1,100 D 2
Berlin, 419 E 3
Berryton, 600 B 1
Bethlehem, 297 C 3
Bibb City, 1,213 D 2
Billarp, 350 C 2
Bir, 300 B 4
Birmingham, 120 B 2
Bishop, 214 C 3
Blackshear, 2,482 E 4
Blairsville, 437 E 3
Blakely, 3,580 E 1
Blalock, 150 B 3
Blanton, 125 F 3
Bloomfield, 4,381 D 2
Bloomington, 1,000 D 5
Blue Ridge, 1,406 B 2
Bluffton, 176 E 2
Blythe, 172 C 4
Bogart, 403 C 3
Bogard, 200 D 4
Bonaville, 100 C 4
Bonneville, 100 C 4
Boston, 1,357 F 3
Bostwick, 272 C 3
Bowdon, 1,155 C 1
Bowdon Junction, 150 C 1
Bowersville, 293 B 3
Bowman, 654 B 3
Bowling, 300 D 3
Boyd, 450 D 3
Boykin, 601 E 2
Bradley, 100 C 3
Brasleton, 255 B 3
Bremen, 3,132 C 1
Brewton, 100 D 4
Bridgeboro, 250 E 3
Bridgman, 216 C 3
Bristow, 162 E 4
Broadhurst, 200 E 5
Bronwood, 400 E 2
Brookfield, 990 E 3
Brookhaven, 8,000 C 2
Brooklet, 557 D 5
Broxton, 907 E 2
Brunswick, 21,703 E 5
Buchanan, 753 E 1
Buckhead, 169 C 3
Buena Vista, 1,574 D 2
Buford, 4,168 B 2
Burwell, 175 C 1
Butler, 1,346 D 2
Byromville, 349 D 3
Byron, 1,138 D 3
Cadley, 260 C 4
Cadeville, 360 F 2
Cairo, 7,427 E 3
Calhoun, 3,587 B 2
Calvary, 700 F 2
Camak, 285 C 4
Camilla, 4,753 E 2
Campton, 200 C 3
Canon, 626 B 3
Canton, 2,411 E 2
Carl, 204 B 3
Carlton, 321 E 2
Carnegie, 113 B 3
Carnesville, 481 B 3
Carrollton, 10,973 C 1
Cartersville, 8,668 B 2
Cassville, 200 B 2
Cataula, 350 D 2
Cave Spring, 1,153 D 3
Cecil, 279 E 2
Cedartown, 9,340 B 1
Celanese Village, 1,500 B 1
Center, 137 B 3
Centerville, 290 D 3
Centralhatchee, 174 C 1
Chalybeate Springs, 295 D 2
Chamblee, 6,635 A 5
Charing, 100 D 2
Charlotteville, 150 D 4
Chatham City, see Garden City
Chatsworth, 1,184 B 2
Chauncey, 370 D 3
Chester, 373 B 3
Chickamauga, 1,824 B 1
Chickopee, 900 B 3
Chula, 300 E 3
Cisco, 200 B 2
Clarkdale, 750 A 4
Clarksville, 1,352 B 3
Clarkston, 1,524 B 5
Claxton, 2,672 D 5
Clyo, 250 D 5
Cobbtown, 280 D 4
Cochran, 4,714 E 3
Coffee, 150 E 4
Coghlin, 210 E 4
Cohutta, 325 B 2
Colbert, 425 B 3

Coleman, 220 E 2
College Park, 23,468 B 5
Collegeboro, 900 D 3
Collins, 565 D 3
Collinsville, 120 D 4
Colquitt, 1,556 D 3
Columbus, 116,779 D 2
Comer, 882 B 3
Commerce, 3,551 B 3
Concord, 333 C 2
Conley, 200 C 3
Constitution, 900 B 3
Conyers, 2,881 B 6
Coolidge, 679 B 6
Coosa, 150 B 1
Cordele, 10,609 E 3
Corinth, 105 C 2
Cornelia, 2,936 B 3
Cotton, 108 E 2
Covena, 105 E 2
Covington, 8,197 E 3
Crandall, 208 B 4
Crawford, 541 C 2
Crawfordville, 786 C 4
Crescent, 300 E 5
Crest, 125 D 2
Crosland, 95 E 3
Crown, 95,1,000 D 3
Culloden, 260 D 3
Cumming, 1,561 B 2
Cusseta, 768 B 2
Cuthbert, 4,300 E 2
Cyrene, 200 F 2
Dacula, 440 C 3
Dahlonega, 2,604 B 3
Daisy, 229 D 3
Dale, 2,065 E 3
Dalton, 17,868 B 2
Damasus, 297 E 2
Danburg, 108 C 4
Danielsville, 362 B 3
Danville, 264 D 3
Darlen, 1,569 E 5
Dasher, 200 F 3
Dawson, 447 E 3
Dawson, 1,062 E 2
Dawsonville, 307 B 2
Deering, 403 C 2
Decatur, 22,026 B 5
Deepstep, 139 C 4
Demorest, 1,029 B 3
Denton, 1,726 E 4
De Soto, 282 E 1
De Soto Park, 700 B 1
Devereux, 200 C 3
Dewey Rose, 150 B 4
Dexter, 359 D 3
Dial, 800 B 2
Dillard, 204 B 3
Dixie, 220 F 3
Dock Junction, 3,920 E 3
Dockett, 350 E 3
Doraville, 1,037 E 4
Donelsonville, 2,621 E 2
Donovan, 125 D 4
Dorain, 300 D 3
Doraville, 4,437 A 5
Double Run, 250 E 3
Douglas, 8,736 C 2
Douglassville, 4,462 C 2
Dover, 1,037 E 4
Draketown, 100 C 1
Dry Hills, 2,000 C 2
Dry Branch, 200 D 3
Dryden, 350 B 3
Dublin, 13,814 D 4
Duffee, 360 D 2
Dudley, 150 B 2
Duluth, 1,480 E 4
Dunwoody, 300 A 5
DuPont, 210 E 4
Durand, 195 D 2
East Dublin, 1,677 D 4
East Ellijay, 501 B 2
East Griffin, 1,715 C 3
East Juliette, 201 C 3
East Newnan, 500 C 2
East Point, 35,633 B 5
East Thomaston, 2,237 D 2
Eastman, 5,118 D 3
Eatonton, 3,612 B 3
Ecota, 800 D 5
Eden, 400 D 3
Edinburg, 232 F 4
Edith, 300 E 4
Egypt, 200 D 5
Elberta, 644 D 3
Elberton, 7,107 E 2
Elizabeth, 1,620 A 4
Elko, 165 D 5
Elkfield, 175 D 2
Ellaville, 905 E 3
Ellenton, 1,385 E 3
Ellenwood, 220 B 2
Ellerslie, 350 D 2
Ellijay, 1,320 B 2
Elmore, 100 B 2
Emerson, 666 B 2
Emma, 135 E 3
Emory University, 200 B 5
Empire, 125 D 3
Enigma, 525 E 3
Ephraim, 500 B 1
Esom Hill, 200 B 2
Eton, 275 E 2
Euharlee, 200 E 5
Eulonia, 200 E 5

*County Seat.

*Does not appear on the map; key shows general location.

*Population of metropolitan area, including suburbs.
Source: Latest available census figures.

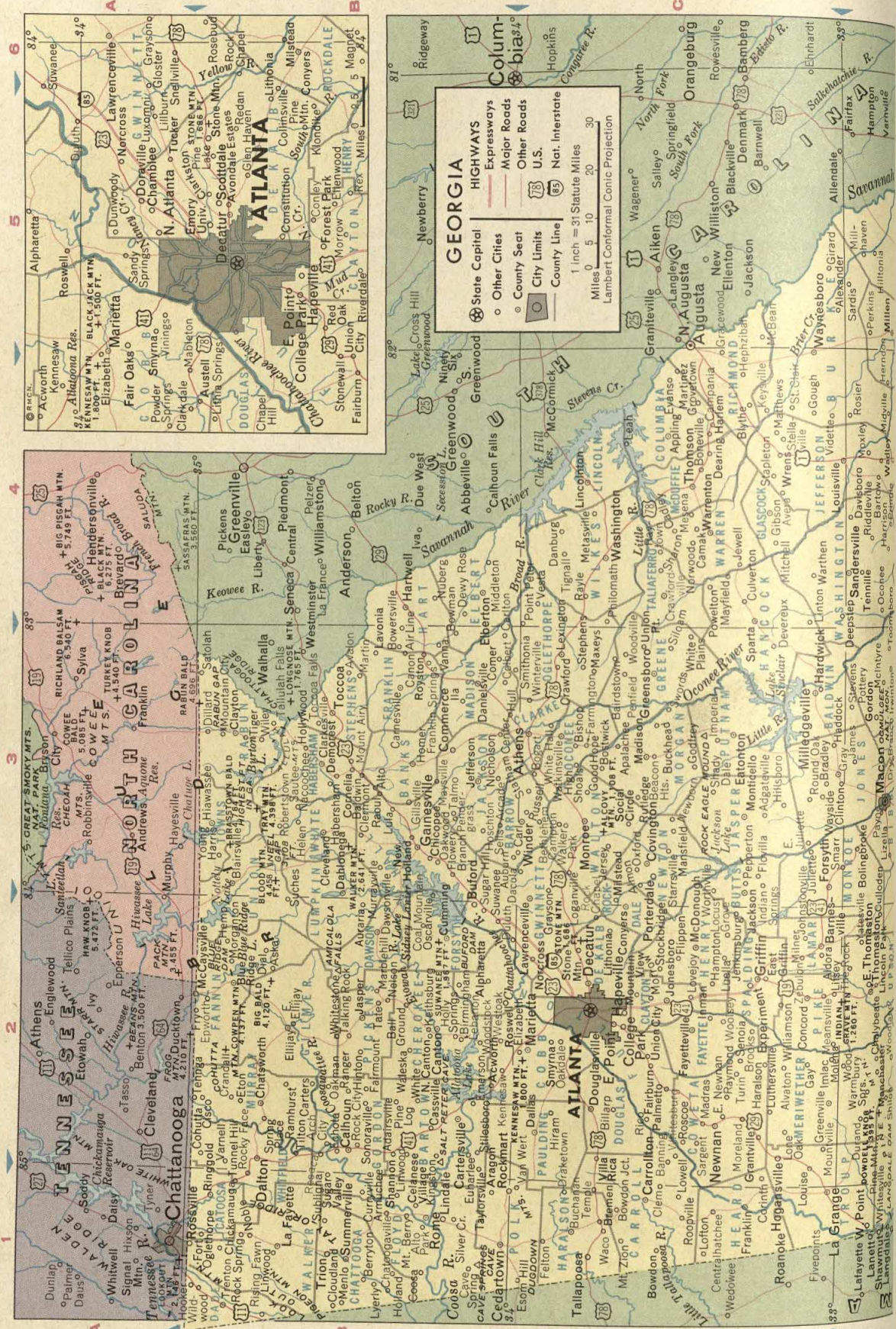


GEORGIA

Evergreen Trees
Mixed Evergreen and Deciduous Trees
Grass

State Capital • Other Cities
Railroads City Limits

1 inch = 46.5 Statute Miles
Miles 0 10 20 30 40 50
Lambert Conformal Conic Projection



GEORGIA

HIGHWAYS

- Expressways
- Major Roads
- Other Roads
- U.S.

Other Symbols

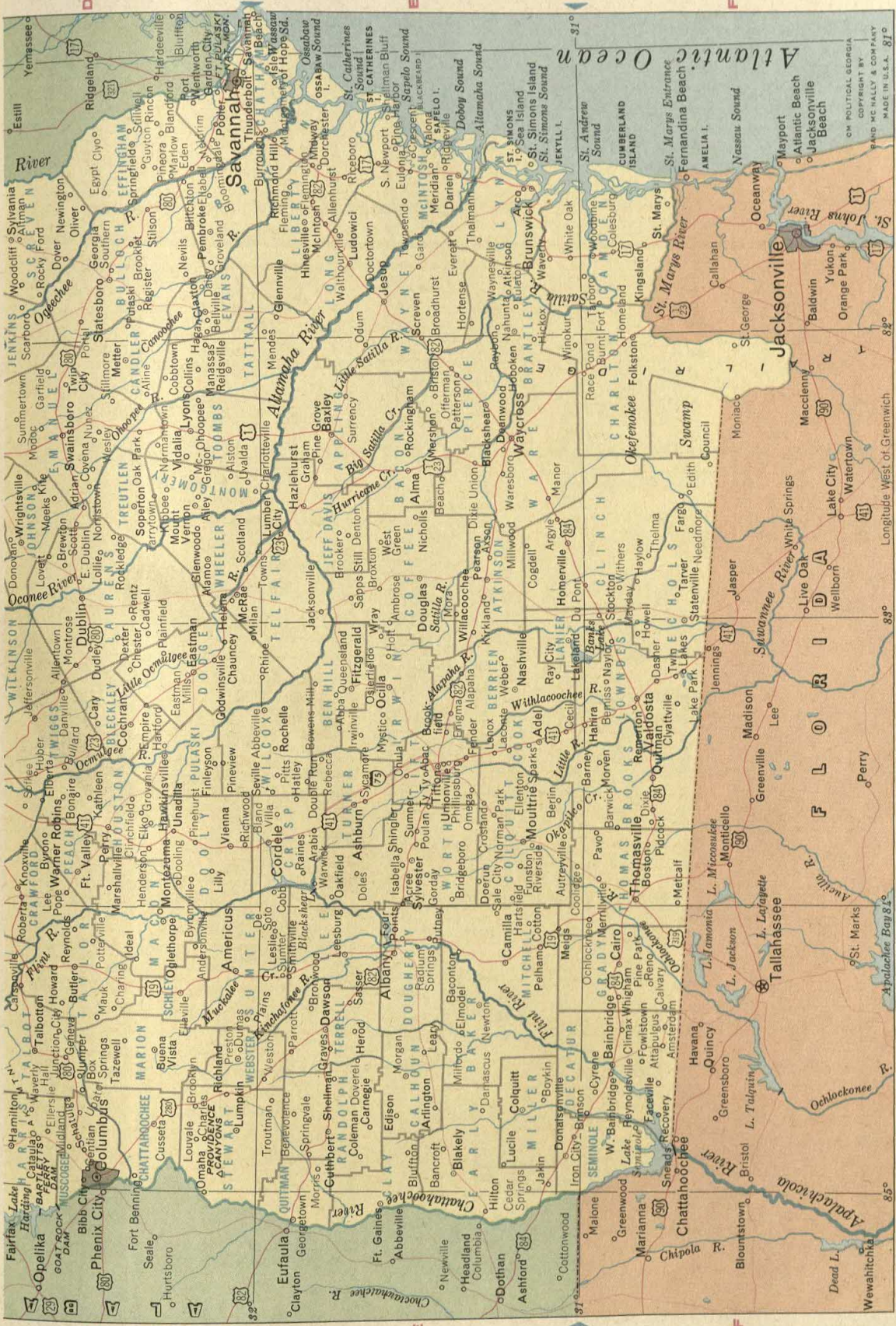
- State Capital
- Other Cities
- County Seat
- County Line
- City Limits

Scale

1 inch = 31 Statute Miles

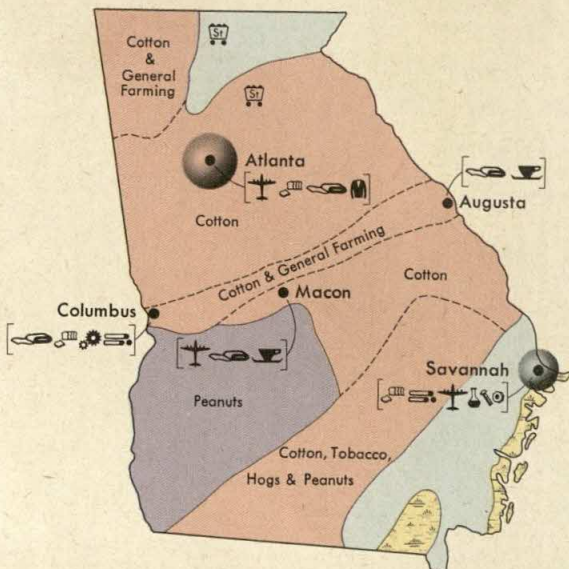
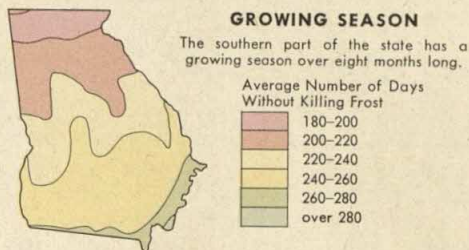
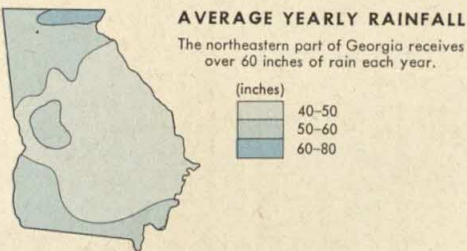
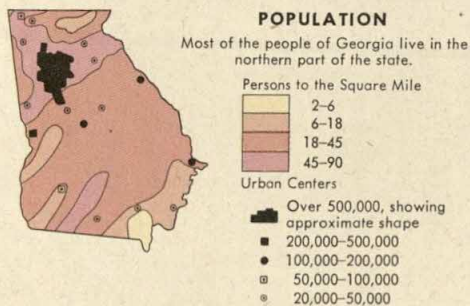
Miles 0 5 10 20 30

Lambert Conformal Conic Projection

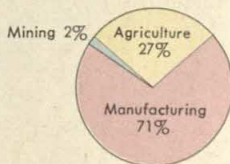


GEORGIA

The maps and graphs on this page show the variations in rainfall, population, and growing season. They also tell the chief ways the people earn their living and the average yearly value of the state's main products.



TOTAL PRODUCTION \$2,546,000,000

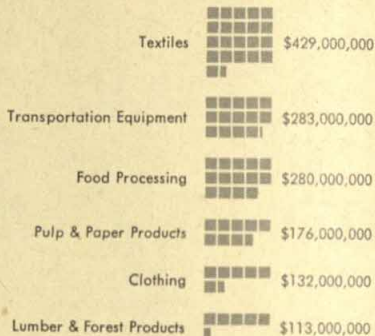


GEORGIA'S LEADING PRODUCTS

Each Box ■ Represents \$20,000,000 Worth of Products.

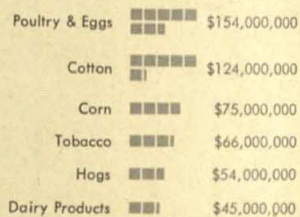
MANUFACTURING

Total Value Added \$1,805,000,000



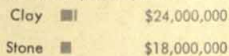
AGRICULTURE

Total \$686,000,000



MINING

Total \$55,000,000

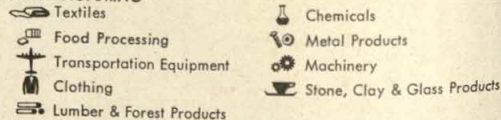


All figures are based on government statistics for a 4 year period.

ECONOMIC ACTIVITY

Textiles account for over 23 per cent of Georgia's manufacturing income.

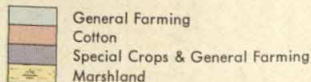
MANUFACTURING



MINING



AGRICULTURE



GEORGIA'S CHIEF MANUFACTURING CENTERS



Evans, 600 C 4
 Everett, 150 E 5
 Experiment, 2,497 C 2
 Faceville, 100 F 2
 Fair Oaks, 7,969 A 5
 Fairburn, 2,470 B 4 C 2
 Fairfax, 150 E 2
 Fairmount, 619 F 4
 Fairview, 2,000 B 1
 Fairytland, 1,000 B 1
 Fargo, 1,000 F 4
 Farmington, 151 C 3
 Fayetteville, 1,389 C 2
 Felton, 160 C 1
 Fender, 150 E 2
 Fensholt, 8,781 E 3
 Five Points, 1,400 E 2
 Flemington, 149 E 5
 Flippin, 400 C 2
 Flovilla, 284 C 3
 Flowery Branch, 741 B 1 C 3
 Folkston, 1,810 F 4
 Forest Park, 14,201 B 5
 Forest, 3,697 C 3
 Fort Gaines, 1,320 E 1
 Fort Oglethorpe, 2,251 B 1
 Fort Valley, 8,310 D 3
 Four Points, 1,200 E 2
 Fowlston, 200 C 1
 Franklin, 603 C 1
 Franklin Springs, 278 B 3
 Fry, 175 B 2
 Fullerville (part of Villa Rica) E 3
 Funston, 293 E 3
 Gadsden, 200 B 2
 Gainesville, 16,523 B 3
 Gainesville Cotton Mills, 2,207 B 3
 Garden City (Chatham County), 5,451 D 5
 Garden Lakes, 1,300 B 1 D 5
 Gardi, 275 E 4
 Gardner, 350 D 4
 Garfield, 225 D 4
 Gay, 194 C 2
 Geneva, 261 D 2
 Gentian, 800 D 2
 Georgetown, 554 E 4
 Gibson, 479 C 1
 Girdard, 248 E 2
 Glen Haven, 2,000 B 5
 Glennville, 2,791 E 5
 Glenwood, 682 D 4
 Godfrey, 181 C 3
 Godwinville, 150 D 3
 Good Hope, 165 C 3
 Gordon, 1,793 D 3
 Gordon, 300 C 4
 Gracewood, 500 C 4
 Graham, 130 E 4
 Grantville, 1,158 C 2
 Graves, 150 E 2
 Gray, 1,320 C 3
 Grayson, 282 A 6, C 3
 Greensboro, 2,773 C 3
 Greenville, 602 C 2
 Greshamville, 180 C 3
 Griffin, 21,735 C 2
 Grovania, 186 D 5
 Groveland, 100 D 5
 Grovetown, 1,396 C 4
 Gulton, 670 D 5
 Hahersham, 800 B 3
 Haddock, 600 C 3
 Hagan, 552 D 5
 Hahira, 1,297 F 3
 Hamilton, 396 D 2
 Hampton, 1,253 C 2
 Hapeville, 10,082 B 5 C 2
 Hazlehurst, 3,699 E 4
 Hazlehurst, 175 C 2
 Hebardville, 2,758 B 3
 Helen, 227 B 3
 Helena, 1,290 D 4
 Helmer, 300 C 2
 Helphibah, 676 C 4
 Herod, 100 E 2
 Hiwassee, 455 B 3
 Hickox, 71 C 4
 Higdon, 151 D 4
 High Shoals, 217 C 3
 Hillsboro, 150 C 5
 Hilltop, 353 D 5
 Hinesville, 3,174 E 5
 Hinton, 400 C 2
 Hiram, 358 C 2
 Hoboken, 552 E 4
 Hogansville, 3,658 C 2
 Holland, 110 B 1
 Holly Springs, 475 B 2
 Hollywood, 150 B 3
 Holmwood, 508 E 4
 Homer, 612 B 3
 Homerville, 2,634 E 4
 Hooker, 300 B 1
 Hortense, 380 E 5
 Hoschton, 378 B 3
 Howard, 200 D 2
 Howell, 141 F 3
 Hull, 119 B 3
 Ideal, 432 D 2

Ila, 216 B 3
 Indian Springs, 250 C 3
 Inman, 175 C 2
 Iron City, 298 E 2
 Irwinton, 673 D 3
 Irwinville, 300 E 3
 Isabelle, 100 E 3
 Isle of Hope, 1,500 D 3
 Ivy Log, 925 B 2
 Jackson, 2,545 C 3
 Jacksonville, 236 E 4
 Jakin, 176 E 2
 James, 150 D 3
 Jasper, 1,036 E 3
 Jefferson, 1,749 D 2
 Jeffersonville, 1,013 D 3
 Jenkinsburg, 233 C 2
 Jersey, 170 C 3
 Jesup, 7,304 E 5
 Jewell, 100 C 4
 Johnstonville, 190 C 2
 Jonesboro, 5,014 C 3
 Juliette, 510 C 3
 Junction City, 226 D 2
 Keithsburg, 300 B 2
 Kennesaw, 1,507 A 4 B 2
 Kensington Park, 1,000 D 5
 Kewville, 150 C 4
 Kibbee, 155 D 2
 Killen, 100 E 1
 Kingsland, 1,536 F 5
 Kingston, 695 B 2
 Kirkland, 150 E 4
 Kite, 424 D 4
 Knoxville, 385 D 3
 Lacombe, 100 E 3
 Lafayette, 5,388 B 3
 La Grange, 26,632 C 1
 Lake City, 1,042 C 2
 Lake Park, 338 F 3
 Lakeland, 2,236 E 3
 Lakeview, 1,000 B 1
 La Vista, 3,000 C 2
 Lawton, 2,088 B 3
 Lawrenceville, 3,804 A 6, C 3
 Leaf, 400 B 3
 Leah, 300 C 4
 Leary, 848 E 2
 Leesburg, 774 E 2
 Leona, 802 E 2
 Leslie, 494 E 2
 Lexington, 376 C 3
 Liburn, 753 A 5
 Lilly, 136 D 3
 Lincoln Park, 1,840 D 2
 Lincolnton, 1,450 C 4
 Lindale, 2,600 E 4
 Linton, 150 C 4
 Linwood, 760 B 2
 Lithia Springs, 222 B 4
 Lithonia, 1,667 B 5 C 2
 Lizella, 450 D 3
 Locust Grove, 369 C 2
 Lofton, 200 C 1
 Loganville, 926 C 4
 Lolia, 147 D 4
 Lone Oak, 122 C 2
 Louise, 120 C 4
 Louisville, 2,413 C 4
 Loveale, 300 D 2
 Lovejoy, 191 C 2
 Ludowick, 1,578 C 2
 Luella, 300 B 3
 Lula, 557 C 3
 Lumber City, 1,360 E 4
 Lumpkin, 1,348 D 2
 Luthersville, 282 C 2
 Luxmuni, 180 A 5
 Lyster, 409 B 1
 Lyons, 3,215 A 4
 Lytle, 7,127 A 4
 Macon, 69,764 D 3
 Madison, 2,680 C 3
 Madras, 200 C 2
 Magnet, 300 B 6
 Manassas, 154 D 4
 Manchester, 4,115 E 4
 Manor, 500 D 2
 Mansfield, 394 C 3
 Marblehill, 150 B 2
 Marietta, 25,565 A 5, C 2
 Marietta East, 4,435 C 2
 Marlow, 100 D 5
 Marshallville, 1,300 B 3
 Martin, 200 B 3
 Martinez, 2,000 C 4
 Matthews, 106 C 4
 Max, 400 D 2
 Maxey, 149 C 3
 Mayfield, 100 B 3
 Maysville, 555 C 2
 McAfee, 3,000 C 2
 McBean, 100 C 5
 McCaysville, 1,871 B 2
 McDonough, 2,224 C 2
 McGregor, 200 D 4
 McIntosh, 150 E 5
 McIntyre, 316 D 4
 McRae, 2,738 D 4
 Meansville, 335 C 2
 Meeks, 100 D 4
 Meigs, 1,236 E 2
 Meldrim, 220 D 5
 Mendes, 150 E 5
 Menlo, 466 E 5
 Meridian, 150 E 5
 Merrillville, 111 F 3
 Mershon, 300 E 4

Mesena, 200 C 4
 Metcalf, 241 F 3
 Metter, 2,362 D 4
 Middleton, 106 B 4
 Midville, 676 D 4
 Midway, 240 E 5
 Milan, 786 D 3
 Milford, 11,117 D 3
 Millen, 3,633 D 3
 Millwood, 900 E 4
 Milner, 305 C 2
 Milledge, 1,047 B 6, C 3
 Mineral Bluff, 149 B 2
 Mitchell, 184 C 4
 Molok, 749 E 2
 Monticello, 123 C 4
 Monroe, 6,826 C 3
 Montezuma, 3,744 D 2
 Montgomery, 350 E 5
 Monticello, 1,931 C 3
 Montrose, 236 D 3
 Mora, 150 D 4
 Mora, 300 D 4
 Moreland, 329 C 2
 Morgan, 293 E 2
 Morganton, 211 B 2
 Morris, 150 E 2
 Morrow, 580 B 5, C 2
 Morven, 476 E 2
 Moultrie, 15,764 E 2
 Mount Airy, 417 B 1
 Mount Berry, 1,000 B 1
 Mount Vernon, 1,166 D 4
 Mount Zion, 211 C 1
 Mountain City, 550 B 3
 Mountain View, 1,550 C 2
 Mountaintown, 150 B 2
 Mountville, 139 C 2
 Murraville, 300 B 3
 Mystic, 274 E 3
 Nahant, 952 E 5
 Nashville, 4,070 E 5
 Navasota, 3,938 D 5
 Nichols, 930 E 4
 Nicholson, 359 B 3
 Noble, 200 B 1
 Norcross, 1,605 A 5 C 2
 Norman Park, 891 E 3
 Norristown, 200 D 4
 North Atlanta, 12,661 A 5 C 2
 North Canton, 1,996 B 2 C 2
 North Decatur, 10,000 C 2
 North Druid Hills, 4,000 C 2
 North High Shoals, 122 C 3
 Northwood, 1,000 C 4
 Norwood, 294 C 4
 Nugent, 100 B 4
 Oak Grove, 3,500 C 2
 Oak Park, 302 D 4
 Oakfield, 141 E 3
 Oakman, 156 B 2
 Oakwood, 148 B 3
 Ochlocknee (Ochlocknee), 502 F 2
 Ocilla, 3,217 E 3
 Oconee, 500 D 4
 Odum, 404 E 4
 Offerman, 483 D 2
 Oglethorpe, 1,169 D 2
 Oliver, 192 D 5
 Omaha, 174 D 2
 Omega, 940 E 3
 Oscarville, 275 B 3
 Osierfield, 82 E 3
 Oxford, 1,047 C 3
 Palmetto, 1,466 E 2
 Parrott, 280 E 2
 Patterson, 719 E 4
 Pavo, 817 F 3
 Paynes (Payne), 346 D 3
 Pearson, 1,615 E 4
 Pelham, 4,609 E 2
 Pembroke, 1,215 B 3
 Pennington, 215 C 3
 Penfield, 105 C 3
 Pennington, 523 C 3
 Perkins, 200 D 5
 Perry, 6,032 D 3
 Phillipsburg, 2,037 E 3
 Philomath, 550 F 3
 Picadilly, 210 E 4
 Pine Grove, 100 E 4
 Pine Harbor, 125 E 5
 Pine Lake, 738 B 5
 Pine Log, 150 B 2
 Pine Mountain, 790 D 2
 Pinehurst, 457 D 3
 Pinedale, 210 D 3
 Pineview, 369 D 3
 Pitts, 383 E 3
 Plains, 572 D 2
 Plainville, 161 B 2
 Point Peter, 200 C 4
 Pooler, 1,073 D 5
 Port Wentworth, 3,705 D 5
 Portal, 494 D 5
 Porterdale, 2,365 C 3
 Potteryville, 400 D 2
 Poulan, 736 E 3

Powder Springs, 746 A 4
 Preston, 232 D 2
 Pulaski, 155 D 5
 Putney, 300 E 2
 Quit, 126 B 1
 Quitman, 5,071 F 3
 Racepoint, 250 F 4
 Ramhurst, 100 B 2
 Ranger, 161 B 2
 Ray City, 713 E 3
 Raydon, 250 E 5
 Reidsville, 1,372 D 4
 Raymond, 300 C 2
 Rebecca, 278 E 3
 Red Hill, 600 B 3
 Red Oak, 800 B 5
 Redan, 250 B 5
 Register, 300 D 5
 Reidsville, 1,229 D 4
 Relee, 200 E 4
 Remerton, 571 F 3
 Rentz, 307 D 4
 Resaca, 325 B 2
 Reynolds, 1,087 D 2
 Rhine, 485 E 3
 Rock, 259 E 5
 Rockland, 1,372 D 4
 Richmond Hill, 1,000 E 2
 Rico, 200 C 2
 Riddleville, 111 D 4
 Ridgeville, 187 E 5
 Rincon, 1,057 D 5
 Ringgold, 1,311 E 1
 Riverdale, 1,045 B 1
 Riverside, 329 E 3
 Roberta, 714 D 3
 Robertstown, 400 B 3
 Rochelle, 1,235 E 3
 Rockledge, 100 D 4
 Rockmart, 3,938 D 5
 Rocky Ford, 124 D 5
 Rome, 32,226 C 1
 Roopville, 203 C 2
 Roscoe, 125 C 2
 Rossville, 4,665 B 1
 Roswell, 2,983 A 5 B 2
 Round Oak, 200 C 2
 Rowles, 2,333 B 3
 Russell, 163 C 3
 Rutledge, 478 C 3
 St. George, 582 F 4
 St. Marys, 3,272 F 5
 St. Simons Island, 3,199 E 5
 State City, 275 E 5
 Sandersville, 5,425 D 4
 Sandy Springs, 5,000 A 5 D 4
 Sapp's Still, 200 E 4
 Sardis, 829 D 5
 Sargent, 950 C 2
 Sasser, 382 E 3
 Sataola, 200 B 3
 Sautee, 300 B 3
 Savannah, 149,245 D 5
 Savannah Beach, 1,385 E 6
 Scarboro, 150 D 5
 Scotland, 236 D 4
 Seale, 148 D 4
 Scottsdale, 4,000 B 5
 Screven, 1,010 E 4
 Sea Island, 300 E 5
 Seabrook, 150 E 5
 Senoia, 782 C 2
 Senoia, 779 C 3
 Sevier, 179 C 3
 Sevier, 179 C 3
 Sevier, 179 C 3
 Sevier, 179 C 3
 Shannon, 1,629 B 1
 Sharon, 264 C 4
 Shellman, 1,050 E 2
 Shiloh, 250 D 2
 Shingler, 300 E 3
 Sileam, 321 C 3
 Silver Creek, 200 B 1
 Silverton (part of Thomaston), 1,782 D 2
 Smithville, 732 E 2
 Smyrna, 10,157 A 5 C 2
 Snellville, 468 A 6
 Social Circle, 1,780 C 3
 Sonoma, 2,317 D 4
 South Decatur, 15,000 C 2
 South Macon, 9,000 D 3
 South Newport, 150 E 5
 Sparks, 1,158 E 3
 Sparta, 1,921 B 2
 Spring Place, 194 B 2
 Springfield, 858 D 5
 Stapleton, 356 C 4
 Starrville, 100 C 3
 Statesville, 400 F 3
 Statesboro, 8,356 D 5
 Statham, 711 C 3
 Stephens, 150 D 3
 Stevens Pottery, 300 D 3
 Stillborn, 650 B 2
 Stillmore, 354 D 4
 Stilson, 160 D 5
 Stockbridge, 1,201 C 2
 Stockton, 500 F 4
 Stone Mountain, 1,576 B 5, C 2
 Stonewall, 800 B 5, C 2
 Stovall, 250 D 2
 Subigna, 150 B 1
 Suches, 600 B 2
 Sugar Hill, 1,175 B 1
 Sugar Valley, 165 B 1

Summertown, 100 D 4
 Summerville, 4,706 B 1
 Summit-Graymont, see Twin City
 Sumter, 190 E 3
 Sunny Side, 190 C 2
 Surrency, 312 E 2
 Swanee, 541 A 5, B 2
 Swainsboro, 5,943 D 4
 Swords, 200 C 3
 Sycamore, 501 E 3
 Sylvana, 3,469 D 3
 Sylvester, 3,610 E 3
 Talbotton, 1,163 D 2
 Tallapoosa, 2,744 C 1
 Tallulah Falls, 225 B 3
 Tarboro, 185 F 5
 Tarrytown, 191 D 4
 Tarver, 178 F 4
 Tate, 900 B 2
 Taylorsville, 226 B 2
 Tazewell, 112 D 2
 Temperance, 125 E 3
 Temple, 788 C 1
 Tennille, 1,837 B 2
 The Rock, 115 D 2
 Thomas, 9,336 D 2
 Thomasville, 18,246 F 3
 Thomson, 4,522 C 4
 Thunderbolt, 1,925 D 5
 Tifton, 9,903 E 3
 Tigner, 277 C 4
 Tignall, 556 C 4
 Toccoa, 7,303 B 3
 Toombsboro, 764 D 3
 Townsend, 100 E 5
 Trenton, 1,301 B 1
 Tuck, 2,227 B 1
 Tuba, 985 B 2
 Tucker, 5,000 A 5
 Tunnel Hill, 255 B 1
 Turin, 183 C 2
 Twin City, 1,095 D 4
 Twin Lakes, 200 F 3
 Ty Ty, 461 E 3
 Union City, 1,304 D 3
 Union Point, 1,615 C 2
 Unionville, 1,607 E 3
 Unionville, 1,000 D 3
 Uvalde, 589 D 3
 Valdosta, 30,652 F 3
 Vanna, 152 B 3
 Van Wert, 311 C 1
 Varnell, 400 B 2
 Vesta, 150 C 4
 Vidalia, 7,569 D 4
 Vidette, 103 E 3
 Villa Rica, 3,450 C 2
 Waco, 381 C 1
 Wadley, 1,898 D 4
 Waleska, 479 B 2
 Walhournville, 600 E 5
 Waresboro, 350 E 2
 Warrenton, 538 D 2
 Warner Robins, 18,633 D 3
 Warrenton, 1,770 C 4
 Warthen, 275 C 4
 Warwick, 434 E 3
 Washington, 4,440 E 3
 Watkinsville, 758 C 3
 Waverly, 165 E 5
 Waverly Hall, 712 D 2
 Wax, 100 B 1
 Waycross, 20,944 E 4
 Waynesboro, 5,359 C 4
 Waynesville, 250 C 3
 Wayzide, 130 C 3
 Weber, 125 E 3
 West Bainbridge, 1,782 F 2
 West Green, 300 E 4
 West Point, 4,610 D 1
 Weston, 120 E 2
 White, 463 F 2
 White, 439 B 2
 White Hall, 409 C 3
 White Oak, 150 E 5
 White Plains, 273 C 3
 White Sulphur Springs, 150 D 2
 Whitesburg, 366 C 2
 Whitestone, 300 B 2
 Whitesville, 500 D 1
 Wiley, 200 B 3
 Willacoochee, 1,061 E 3
 Williamson, 215 D 5
 Willing, 192 B 2
 Winder, 5,555 C 3
 Winterville, 497 C 3
 Woodbine, 845 F 5
 Woodbury, 1,230 D 2
 Woodland, 720 D 2
 Woodstock, 726 C 3
 Woodville, 372 B 3
 Worthville, 100 C 3
 Wray, 125 E 3
 Wrens, 1,628 C 4
 Wrightsville, 2,056 D 4
 Yatesville, 354 D 2
 Yeomans, 400 D 2
 Young Harris, 743 B 3
 Zebulon, 563 C 2
 Zetto, 300 E 2

(Map Index) GEORGIA

*County Seat.
 *Does not appear on the map; key shows general location.

*Population of metropolitan area, including suburbs.
 Source: Latest available census figures.

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wide belt running east and west through central Georgia. This gently rolling area slopes up from less than 400 feet above sea level in the south to about 1,500 feet in the north. The cities of the region and those along its southern boundary make it the most densely populated section of Georgia. They include Atlanta, Columbus, Macon, and Augusta. The southern boundary of the Piedmont is known as the "fall line," because rapids and falls occur where streams cross it (see FALL LINE).

The Atlantic Coastal Plain spreads across more than a fourth of the state in the southeast. This flat plain has a light, sandy loam soil that favors the growing of peanuts, tobacco, sweet potatoes, and watermelons. Okefenokee Swamp lies in the southern part of the plain and extends into the East Gulf Coastal Plain (see OKEFENOKEE SWAMP).

The East Gulf Coastal Plain covers almost a fourth of the state in the southwest. Its soils, crops, and flat surface are similar to those of the Atlantic Coastal Plain. The rivers draining the East Gulf Coastal Plain flow to the Gulf of Mexico, and those that drain the Atlantic Coastal Plain flow into the Atlantic.

Coast Line. Georgia has 96 miles of coast line on the Atlantic Ocean. The principal ports are Savannah and Brunswick. The Golden Isles, a string of islands along the coast, are popular resorts.

Mountains. The Appalachian Highlands extend into northern Georgia from North Carolina and Tennessee, and cover about 1,850 square miles. The Blue Ridge is the main backbone of these mountains. Travelers can easily cross the Highlands at Rabun Gap in the northeastern corner of the state, and at Ellijay Valley in north-central Georgia. A steep climb is necessary to cross at other places. The highest peak in Georgia is Brasstown Bald, or Mount Enotah (4,784 feet), near the town of Young Harris. Most of the Blue Ridge lies 3,000 feet above sea level, and 18 peaks in Georgia rise above 4,000 feet.

Rivers, Waterfalls, and Lakes. The streams of northwestern Georgia empty into the Tennessee River. But most of the state's rivers follow the general slope of the land and flow directly to the Atlantic Ocean or the Gulf of Mexico. The large rivers include the Savannah, the Altamaha, the Flint, and the Chattahoochee.

The most scenic waterfalls in the state include Amicalola and Toccoa. Amicalola Falls on Amicalola Creek plunges 729 feet near Dawsonville. Toccoa Falls, formed by Toccoa Creek in the town of Toccoa, drops 186 feet. Hydroelectric power dams form beautiful lakes on many rivers. The lakes include Clark Hill Reservoir on the Savannah River, Jim Woodruff Reservoir on the Flint and Chattahoochee rivers, Lake Lanier on the Chattahoochee, Allatoona Lake on the Etowah River, and Lake Sinclair on the Oconee.

Natural Resources of Georgia include about 24,000,000 acres of forests; rivers and lakes that provide water for electric power; rich soils; and a variety of minerals, including three fourths of the nation's kaolin, used in making porcelain.

Soils. The valleys in the mountains of northern Georgia have fertile alluvial soils washed down from the mountains. The Appalachian Ridge and Valley Region is noted for exceptionally rich valley soils. Ridges

in this region have coarse, sandy soil, with low fertility. Clay loams with red clay subsoils cover the Piedmont, and often give many of the hillsides a red color. The soils of the coastal plains are easily cultivated, sandy loams of moderate fertility. Thin, sandy soils cover the Appalachian Plateau.

Minerals. Clays, the state's most important minerals, lie along the southern edge of the Piedmont. This region also has deposits of granite. Georgia's chief marble deposits are in Pickens County. The north-central Piedmont has a small quantity of gold, and rich deposits of feldspar, granite, and quartz. Most of the gold in the United States came from this region until 1849, when larger deposits were discovered in California. The state's richest deposits of manganese and barite lie in the Appalachian Ridge and Valley Region. Mineral resources of the coastal plains include bauxite, kaolin, fuller's earth, and claylike materials called bentonites, used in oil drilling. The state's few coal deposits lie in the Appalachian Plateau. Iron ores occur in the Appalachian Plateau and the Appalachian Ridge and Valley regions, and also southeast of Columbus. Other minerals include asbestos, beryllium, lime, mica, slate, and talc.

Forests cover almost two thirds of Georgia. The more than 160 kinds of trees include pine, oak, gum, cedar, poplar, hickory, cherry, and walnut. A belt of pine and hardwood trees covers the northern half of the state. The southern half has chiefly pine trees, and magnificent live oaks, the state tree. Maple, oak, hickory, birch, and beech trees cover portions of the Blue Ridge. Georgia leads the nation in reforestation. From 1938 to 1958, more than 600,000 acres in Georgia were planted in trees.

Plant Life. Rhododendron and laurel grow in the mountains. Beneath the tall trees of the coastal area is a thick undergrowth of grass, small shrubs, palmettos, and vines. Wild flowers, which add to the natural beauty throughout the state, include the Cherokee rose, violets, daisies, and Japanese honeysuckle.

Animal Life in Georgia includes the bear, beaver, deer, fox, opossum, rabbit, raccoon, and squirrel. About 350 kinds of birds live in the state. Game birds include quail, doves, wild turkeys, marsh hens, ruffed grouse, and many kinds of ducks. Songbirds include the mocking bird, wood thrush, and brown thrasher. Okefenokee Swamp is one of the largest natural bird refuges in the nation. It covers 700 square miles. Rainbow trout, catfish, eels, bass, bream, shad, and mackerel swim in the rivers and streams. Turtles live along the coast. Alligators, shrimp, oysters, and crabs are also plentiful in the coastal waters.

Climate. Georgia has a moderate climate, with an average annual temperature of 65° F. It has an average July temperature of 78° F. In September, 1925, the temperature climbed to a record 111° F. at Americus. The temperature slipped to an all-time low of -17° F. near Lafayette in January, 1940, but the winters are usually short and mild. January temperatures average 45° F. Georgia has an average snowfall of 1 inch a year, most of it in the north.

About 47 inches of rain falls each year in Georgia. July and August are the rainiest months. The driest months are October and November. These weather conditions, and the absence of frost in most areas for about 210 days a year, especially favor the raising of

cotton, which requires a wet growing season and a dry harvest period. Rabun and Towns counties in the northeast have an average annual rainfall of about 80 inches.

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Life of the People

The People. The U.S. Bureau of the Census reported that Georgia had a population of 3,943,116 in 1960, or about 67 persons to the square mile. This was an increase of 15 per cent over 1950. About 72 of every 100 persons are American-born whites, chiefly of English, Scottish, Irish, and German descent. About 28 of every 100 persons are Negro. About 55 of every 100 Georgians live in cities, and the rest in rural areas.

The Baptist Church is the largest religious group in Georgia, with the Methodist Church ranking second. Other groups include the Presbyterian, Episcopalian, Lutheran, Christian, Roman Catholic, and Jewish.

Favorite foods in Georgia include hominy grits, sweet potatoes, corn bread, fried chicken, and peaches. Turnip greens and pot liquor, the liquid remaining in the pot after the greens are cooked, is another favorite. Many families eat black-eyed peas and hog jowl on New Year's Day to bring luck. Coca-Cola, which originated in Georgia, is popular in much of the world.

Cities. Atlanta, where about one eighth of Georgia's people live, is the leading commercial center of the Southeast. Its people have preserved much of the easy-going life of the Old South. Trees and lawns line the streets, and zoning laws ban industries from residential areas. Georgia has 33 other cities with populations of over 10,000. The largest include Savannah, Columbus, Augusta, and Macon. See the separate articles on Georgia cities listed in the *Related Articles* at the end of this article.

Country Life. Small villages throughout the state serve as trading centers for neighboring farms. Some farmers live in villages or small towns instead of on the farms where they work. Most of the country houses are made of wood. A typical farmhouse has about five rooms, with two or more sheds nearby. Georgia farmers are often called "wool hats," because of their felt hats. Many farms have a few "coon" and "possum" dogs for hunting, a favorite sport. Farmers often gather on courthouse steps or at crossroad stores and discuss politics. In many small towns, a statue of a Confederate soldier stands guard before the courthouse.

Saturday afternoon is a holiday for many Georgians in farm areas. They flock into the villages and fill the streets and stores. Activities sponsored by the churches play a large part in the social life of farm families. Churches, or their Sunday schools, sponsor picnics and barbecues. Many churches have dining halls where family-night suppers are served one night each week.

Work of the People

Georgia has changed since the 1920's from an agricultural state to an agricultural-industrial state. The chief reasons for this change include the mild climate, a ready supply of labor, good transportation, nearness of factories to raw materials, and adequate electric power. About 23 of every 100 employed persons work in manufacturing, 21 in farming, 16 in wholesale and retail trade, and 5 in construction and the building trades.

Agriculture. Georgia has long summers, and abundant rainfall favorable for a wide variety of crops. In

addition, the soils respond well to fertilizers. Most of the types of crops grown in the United States can be raised in the valleys, fertile plains, or rolling uplands of Georgia. The average farm in Georgia covers about 130 acres.

Cotton and Other Field Crops. For more than a hundred years after Eli Whitney invented the cotton gin in 1793, Georgia farmers depended chiefly on cotton for income. Until the 1930's, the constant planting of cotton reduced the fertility of much of Georgia's soil. Cotton is still the state's most important crop, but the farmers no longer rely upon a single crop for income. Cotton grows everywhere in Georgia except in the coastal and mountain areas. Farmers grow tobacco in the central and southern sections. The state ranks among the leaders in cotton and tobacco production.

Almost every farmer raises corn. Other grain crops include wheat, barley, and oats. Georgia leads the nation in growing peanuts, and is one of the leaders in growing pecans. Georgia farmers grow peanuts throughout the Piedmont and coastal areas. After they harvest the peanut crop, they often turn their hogs into the fields to eat the plants.

The area around Albany is one of the chief centers in the United States for the production of paper-shell pecans. Sorghum grows in the southwest. Grady County leads the state in production of tung nuts, used to make tung oil, a drying agent. Georgia ranks second among the states in raising watermelons.

Fruits and Vegetables. Macon is the center of Georgia's peach-growing belt. Famous varieties of peaches developed here include the Georgia Belle, Hiley Belle, Elberta, and Hale. Apples grow in the Highlands area, especially in Habersham and Rabun counties. The state ranks fourth in the production of cantaloupes and honeydew melons. Other important fruits include grapes, pears, plums, and several kinds of berries. Georgia ranks first in production of pimiento peppers. Other vegetables include asparagus, tomatoes, collards, potatoes, celery, lettuce, peas, cucumbers, okra, beans, onions, and cabbage.

Livestock. Georgia's income from beef cattle increased more than 500 per cent between the mid-1940's and the mid-1950's. Many Georgia farmers began raising cattle during this period. The mild climate allows economical forage-grass feeds to grow most of the year. Purebred cows supply milk. Other important livestock includes hogs and poultry. Georgia leads the nation in broiler-chicken production, with nearly 240,000,000 broilers a year. It also ranks as one of the leading mule-raising states. Farmers often keep bees and sell the honey.

Manufacturing and Processing. The production of cotton textiles is the oldest and most important Georgia industry. Dalton, Macon, La Grange, Columbus, and other cities have cotton mills. Other leading manufactures include lumber, paper and pulp, food products, clothing, transportation equipment, automobiles, and chemicals. Silvertown has one of the world's largest mills for making rayon and nylon cords for automobile tires.

Leading cottonseed-oil products include cooking fat and soap. Farmers use cottonseed meal as cattle feed and fertilizer. Another important industry is crushing peanuts for oil and peanut butter. Dawson has many large peanut-processing plants. Cairo ranks as one of

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the largest cane-sirup refining centers in the United States. Other factories process and pack fruits, vegetables, and sea foods. Brick, tile, terra cotta, earthenware, and other clay products come from factories at Macon, Atlanta, Augusta, Columbus, and Milledgeville. Important products also include building stone, fertilizer, cement products, paint, varnish, glassware, and tung oil.

Mining. Nonmetals account for most of Georgia's mineral production. Clay and clay products make up about half the total. Georgia is the leading producer of kaolin. One of the world's greatest kaolin belts stretches from Columbus to Augusta. Manufacturers use kaolin for porcelain. Georgia ranks second in the production of fuller's earth, a sandy clay used to refine mineral and vegetable oils.

Georgia stands first in granite production. Large quantities of granite are quarried in the Piedmont region. Georgia is third in marble production. A fine-grained marble comes from quarries near Tate. The Appalachian Valley furnishes a fine grade of limestone.

Georgia ranks second to Arkansas in the production of bauxite, the ore used to make aluminum. The largest deposits of yellow ocher in the world lie near Cartersville. This claylike iron ore is used in linoleum and paints. Barite, also found in this region, can be used as a substitute for white lead in paper, rubber, and oilcloth. Miners dig small amounts of coal and iron in northwestern Georgia. Various sections of the Appalachian region have gold deposits. The nation's first gold rush took place in 1828 when gold was discovered near Dahlonega. Gold mining in this region stopped after richer gold veins were discovered in California.

Forest Industry. The pine and hardwood forests of Georgia provide many raw materials for large industries. The state ranks first in production of turpentine, rosin, and pine oil. These products come from the yellow-pine forests of southern Georgia. Savannah and Brunswick have large turpentine and rosin refineries. Other pine products include lumber, barrels, and railroad ties. Cellulose from pine trees forms the base for rayon, cellophane, and plastics. Lumberjacks cut beautifully grained white oaks and other hardwoods from the northern part of the state for making furniture, flooring, and interior finishings. Paper mills turn the slash-pine lumber of southern Georgia into many grades of paper, from paperboard to newsprint.

Fishing Industry. Georgia is among the leading shrimp-producing states. Almost 15,000,000 pounds of shrimps are processed each year in Savannah. Commercial fishermen also catch crabs, oysters, and shad along the South Atlantic Coast.

Electric Power. About a fourth of Georgia's potential hydroelectric power has been developed. Dammed rivers in the Appalachian Mountains provide much of the electric power. Large hydroelectric plants include Clark Hill Dam on the Savannah River, Buford Dam on the Chattahoochee, and Allatoona Dam on the Etowah. Other large plants stand in the mountains north of Tallulah Falls. Coal-burning steam plants in Atlanta, Macon, Newnan, Rome, and other cities also supply electricity. For Georgia's kilowatt-hour production, see ELECTRIC POWER (table).

Transportation. Atlanta ranks as one of the nation's

chief transportation centers. Airlines, highways, railroads, and ships serve the state.

Aviation. Airlines link Georgia with all parts of the United States. Atlanta has one of the 10 largest airports in the country, and Georgia has more than 40 airports.

Railroads. Atlanta is the most important railroad center in the Southeast. The main lines of several railroads link the city with the rest of the country. An extensive system of railroads was developed in Georgia before the Civil War, and today the state has about 6,000 miles of main-line track.

Roads and Highways. Georgia has more than 90,000 miles of roads, over half of which are paved. The state began a program of paving farm-to-market county roads after World War II.

Shipping. Georgia's two chief ports, Savannah and Brunswick, provide steamer service to many countries. The State Port at Savannah, a quartermaster depot that Georgia bought from the federal government, is one of the most modern port facilities in the world. About \$100,000,000 worth of exports pass through the port of Savannah every year. In 1819, the Savannah Steam Ship Company sent the *Savannah* to Liverpool, England. It was the first steamship to cross the Atlantic. See SAVANNAH.

Waterways. Georgia's part of the Atlantic Intracoastal Waterway carries about 500,000 tons of shipping annually (see ATLANTIC INTRACOASTAL WATERWAY). The Savannah River is navigable to Augusta, and the Flint River to Bainbridge. Barges travel up the Altamaha River to docks near Baxley.

Communication. The state's first newspaper, the *Georgia Gazette*, was founded at Savannah in 1763. The *Cherokee Phoenix*, the world's first newspaper published by and for Indians, started at New Echota in 1828. It was printed in the Cherokee alphabet. The *Augusta Chronicle*, Georgia's oldest newspaper still being published, appeared in 1785.

More than 300 magazines and daily and weekly newspapers are published in the state. The *Atlanta Journal*, the *Atlanta Constitution*, and the *Savannah Morning News* lead in circulation. Atlanta, Savannah, Macon, and other cities have book-publishing firms.

The *Atlanta Journal* established the South's first radio station, WSB, in 1922. WSB became the first radio station in the United States to have regular nightly programs and a broadcasting slogan, "The Voice of the South." WSB also originated the use of musical notes for station identification. The first television station in the South was WSB-TV, established at Atlanta in 1948.

Education

Schools. In the state's early history, rich planters employed tutors for their children. Farmers in a community often joined together to employ a teacher for their children. "Old field schools" began in this way. In 1817, the state set up a fund to pay the tuition of children whose parents were poor. The state also made grants of money from time to time to help build academies. A few cities and counties had good schools, but there was no effective system of public schools in Georgia before the Civil War. "Manual-labor" schools were started after 1830. At these schools, students could pay part of their expenses by working on the school farms. Mercer, Emory, and Oglethorpe universities were

manual-labor schools at one time. Gustavus Orr, state commissioner of education after 1872, started so many public-school improvements that he became known as "the father of the Georgia free school system." But the state did not finance high schools until 1912. In 1902, Martha Berry founded the famous Berry School for mountain children at Mount Berry.

The state spends more than half its income on education. The law requires all children between the ages of 7 and 16 to attend school. Between 1950 and 1955, the state appropriation for public schools more than doubled. This increase was made possible by the adoption of a general sales tax in 1951. For the number of students and teachers in Georgia, see EDUCATION (table).

The University of Georgia, founded in 1785, is one of the oldest state-chartered universities in the United States. It forms one of the 19 units of the state university system. The state has 26 accredited four-year colleges and universities, 5 nonaccredited four-year colleges, and 16 junior colleges.

Libraries. The trustees of the Georgia colony established a library as early as 1741. In 1887, Francis T. Willis, a physician of Richmond, Va., gave Georgia its first free library, the Mary Willis Free Library at Washington. The Young Men's Christian Association established one of the first libraries in Atlanta in 1867. This library was opened to the public in 1902, and now is the Atlanta Public Library. The state has about 20 regional, 80 county, and 40 independent local libraries. Bookmobiles serve farm communities in about half the counties. The University of Georgia and Emory University have the largest libraries in the state.

Museums. The museum at the Ocmulgee National Monument, near Macon, has exhibits that explain the

burial grounds, a prehistoric cornfield, and an earth-lodge (council chamber) in the area. It is one of the largest Indian-history museums in the country.

The Telfair Academy of Arts and Sciences in Savannah is one of the South's finest art galleries. Other leading art museums include the High Museum of Art in Atlanta, and the Georgia Museum of Art at the University of Georgia.

The Arts

Architecture. The early architecture of Savannah and other coastal cities showed English influence. William Jay, a noted English architect, came to Savannah early in the 1800's. The Federal-style homes that he built there are among the finest of this type in America. The planters of the Piedmont favored the Greek Revival style. Many impressive white-columned homes of the pre-Civil War period still stand in that region.

Literature. Customs brought from other lands in the 1700's helped produce a folklore that influenced Georgia writers of the 1800's. This folklore is found in the philosophy of Augustus Baldwin Longstreet and Charles H. Smith, known as Bill Arp. Other tales originating in Georgia include the Uncle Remus stories of Joel Chandler Harris, the Negro tales of Harry Stillwell Edwards, and the mountaineer stories of Will N. Harben. The most celebrated poet of Georgia was Sidney Lanier. The poet Frank L. Stanton wrote the lyrics of "Mighty Lak a Rose," and Robert Loveman wrote "Rain Song."

One of Georgia's best-known writers, Margaret Mitchell, wrote the historical novel *Gone with the Wind*, for which she won a Pulitzer prize in 1937. Another Georgian, Caroline Miller, won a Pulitzer prize in 1934 for her novel *Lamb in His Bosom*. Erskine Caldwell wrote *Tobacco Road* and other books concerning Southern social problems. Laurence Stallings and Ward Morehouse became famous playwrights.

Painting and Sculpture. In the early days, "rider artists" traveled from town to town on horseback, painting pictures of wealthy planters and their families. One of the state's leading painters today is Lamar Dodd, head of the art department of the University of Georgia. Many works of Edward Kemeys, a Georgia sculptor, are exhibited in the National Gallery of Art at Washington, D.C.

Interesting Places to Visit

Georgia's natural beauty and famous resorts attract visitors from all parts of the country. Vacationers enjoy the water sports and luxury hotels of Sea Island and the other Golden Isles along the coast. Since Indian days, sick people have bathed in the soothing waters at Warm Springs. It is now a treatment center for polio patients. See WARM SPRINGS FOUNDATION, GEORGIA.

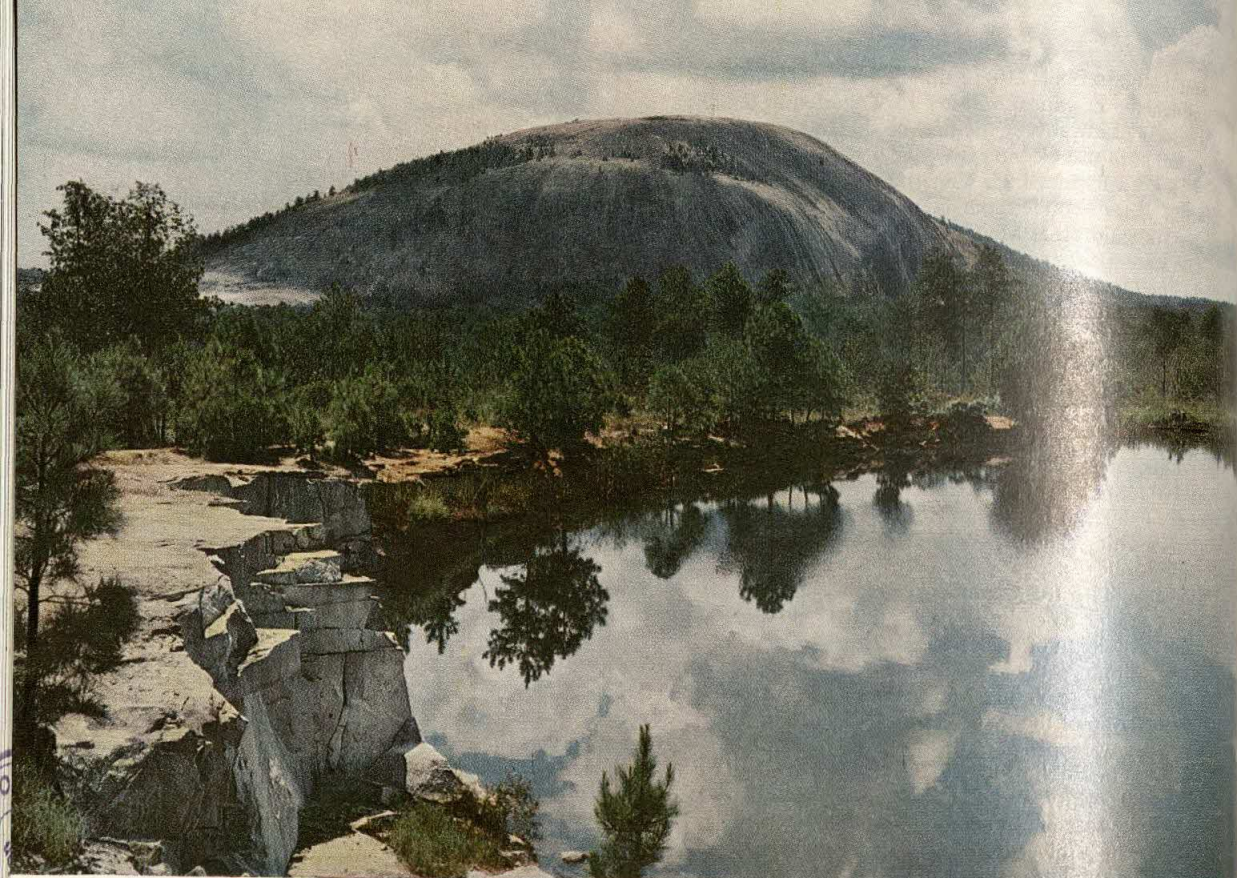
Rushing streams and thick forests abound with fish and game. Sportsmen enjoy Georgia's lakes, streams, and seashore, where they fish for trout, bass, flounder, and mullet. Hunters stalk quail, deer, and fox. Georgia has many fine recreational parks. The Augusta National Golf Course ranks among the best in the country.

Many beautiful monuments and parks dot the landscape as reminders of important Civil War events. Stone Mountain, near Atlanta, rises 1,686 feet and measures 7 miles around its base. For a description of the huge

UNIVERSITIES AND COLLEGES

The following accredited universities and colleges have separate articles in THE WORLD BOOK ENCYCLOPEDIA. For enrollments, see UNIVERSITIES AND COLLEGES (table).

NAME	LOCATION	FOUNDED
Agnes Scott College	Decatur	1889
Albany State College	Albany	1903
Atlanta University	Atlanta	1865
Berry College	Mt. Berry	1902
Brenau College	Gainesville	1878
Clark College	Atlanta	1869
Emory University	Atlanta	1836
Fort Valley State College	Fort Valley	1895
Georgia, University of	Athens	1785
Georgia Institute of Technology	Atlanta	1885
Georgia Southern College	Statesboro	1908
Georgia State College for Women	Milledgeville	1889
Georgia State College of Business Administration	Atlanta	1914
La Grange College	La Grange	1831
Mercer University	Macon	1833
Morehouse College	Atlanta	1867
Morris Brown College	Atlanta	1885
North Georgia College	Dahlonega	1873
Oglethorpe University	Atlanta	1835
Paine College	Augusta	1882
Savannah State College	Savannah	1890
Shorter College	Rome	1873
Spelman College	Atlanta	1881
Tift College	Forsyth	1849
Valdosta State College	Valdosta	1906
Wesleyan College	Macon	1836



Shostal

Stone Mountain, one of the largest exposed granite masses in North America, lies about 16 miles east of Atlanta. It is about 2 miles long, and rises 1,686 feet above sea level.



Shostal; Carolyn Carter

Georgia Peaches are famous throughout the United States. Peach varieties that originated in the state include Georgia Belle, Hiley Belle, Elberta, and Hale.



Turpentine is made from the gummy sap of the pine tree. Workers use metal cups to gather the sap from long cuts in the trees. Georgia leads in the production of turpentine.

Okefenokee Swamp forms a wildlife refuge in southeastern Georgia and Florida. This 700-square-mile area is a haven for alligators, bears, birds, and other wildlife.

The Masters Tournament pits the nation's greatest golfers against each other every April. It takes place on the Augusta National Golf Course.



Gerlach, Shostal

"Way Down upon de Swanee Ribber." Georgia's Suwannee River was made famous by Stephen Foster's song, "Old Folks at Home." It rises near Waycross and helps drain the Okefenokee Swamp.

Shostal



Shostal

Kurt Innecken, Jr., F.P.G.



Tobacco Harvesting begins in late summer. Platformed tractors often carry workers through the fields while they pick the mature leaves.



GEORGIA

figures of Civil War heroes carved on the side of the mountain, see **STONE MOUNTAIN**.

Several of the nation's Presidents have made their vacation homes in Georgia. Franklin D. Roosevelt's "Little White House" was in Warm Springs, and Dwight D. Eisenhower vacationed at Augusta.

Some places of special interest include the following:

Bethesda, near Savannah, is the oldest orphanage in America. It was founded in 1740 by two Anglican ministers, George Whitefield and James Habersham.

Etowah Mounds, near Cartersville, were built by prehistoric Indians. Here, one of the nation's largest Indian mounds rises 65 feet and covers 3 acres. A museum displays sculptured images, pottery, flint blades, and other objects found in excavating.

Ida Cason Gardens, near Chipley, include 1,200 acres of green meadows, rolling hills, woodlands, and lakes. The gardens have facilities for fishing, boating, swimming, golfing, dancing, and dining.

Midway Church, between Savannah and Darien, was built in 1792. It resembles a colonial New England meetinghouse. Abiel Holmes, the father of Oliver Wendell Holmes, was one of the early pastors.

Nacoochee Indian Mound, near Cleveland, is 20 feet high, 150 feet wide, and 190 feet long. It stood in the center of Gauxile, a Cherokee town which De Soto probably visited in 1540.

Old Slave Market, in Louisville, is one of the nation's few remaining slave-market buildings.

Tybee Lighthouse stands at the mouth of the Savannah River. In 1736, James Oglethorpe built a tower of pine on a brick foundation at this site. It was replaced by a brick tower in 1773. The lighthouse, destroyed by Confederates in 1862, was restored in 1867.

Wren's Nest, at Atlanta, was the home of Joel Chandler Harris. It became a memorial in 1913, and contains a collection of the author's personal possessions and original editions of his works.

Yamacraw Bluff, at Savannah, is where James Oglethorpe landed in 1733. The bluff bears the name of the village whose Indians made the first treaty with Oglethorpe.

National Parks, Forests, and Monuments. The nation's largest and oldest national military park is Chickamauga and Chattanooga National Military Park. Established in 1890, it covers 8,190 acres in northwestern Georgia and southern Tennessee, near Chattanooga. The park includes two great Civil War battlefields. Kennesaw Mountain National Battlefield Park (3,000 acres), near Marietta, includes the battlefield where General William T. Sherman made one of his heavy assaults during the Atlanta campaign of 1864. Andersonville Prison Park (80 acres) is the site of Camp Sumter, one of the Confederacy's largest prison camps. Chattahoochee National Forest (679,601 acres) lies in the beautiful Highlands. Oconee National Forest (96,066 acres), near Eatonton, is Georgia's other national forest.

Georgia has three national monuments: Ocmulgee, near Macon; Fort Pulaski, at the mouth of the Savannah River; and Fort Frederica, on St. Simons Island. Each of Georgia's national monuments is described under its own name in **WORLD BOOK**.

State Parks. Georgia has over 20 state parks. The following list includes the more important areas.

Alexander H. Stephens Memorial (1,175 acres), at Crawfordsville, is a memorial to the Vice-President of the Confederacy. The park surrounds Stephens' restored home, Liberty Hall. It has facilities for swimming and boating on Lake Liberty, and tennis, hiking, and softball. Established in 1937.

Chehaw (600 acres), three miles north of Albany, was named for a friendly Indian tribe. Trails wind beneath the park's moss-covered trees. It has a lake, clubhouse, and cabins. Established in 1937.

Franklin D. Roosevelt (5,063 acres), 12 miles from Warm Springs, is near the Little White House, the President's Georgia home and the place of his death. The park has two lakes, a swimming pool, an inn, and cabins. Established in 1947, it was first called Pine Mountain.

Georgia Veterans Memorial (1,000 acres), near Cordele on the shores of Lake Blackshear, honors Georgia's war dead. It has fishing, boating, swimming, riding, and picnic facilities. Established in 1946.

Indian Springs (152 acres), five miles from Jackson, has mineral springs which the Creek Indians used for medicine. A museum displays Indian relics. The park has picnic areas and camping grounds. Established in 1825, it is one of America's oldest state parks.

Jefferson Davis Memorial (12 acres), near Irwinville, marks the spot where the President of the Confederacy was captured by Union troops in 1865. It has a Confederate museum. Established in 1920.

Vogel (228 acres) is in Chattahoochee National Forest. It has facilities for swimming, fishing, boating, and horseback riding. Established in 1927.

Annual Events in Georgia

Georgia's best-known annual event is probably the Masters Golf Tournament, held the second week in April at the Augusta National Golf Course. The nation's top golfers compete in this famous tournament.

Other annual events in Georgia include the following:

January-February, Camellia shows in the central and southern parts of the state, January through February.

February, Georgia Day, Feb. 12.

March, Women Title Holders Golf Match at Augusta, last week; Ham and Egg Show at Fort Valley, no fixed date.

April, Dogwood Festival at Atlanta, mid-April; Thomasville Rose Show at Thomasville, last Friday.

June, Blessing of the Fleet at Thunderbolt, no fixed date.

June-July, Poultry Festival at Gainesville, no fixed date; Boat Regatta at St. Simons Island, no fixed date.

August, Tobacco Festival at Moultrie, no fixed date; Georgia Mountain Fair at Hiawassee, no fixed date.

September, Southeastern Fair at Atlanta, usually second week.

October, Kennesaw Mountain Seminar at Kennesaw Mountain National Battlefield Park, first Friday and Saturday; Pulaski Day at Savannah, Oct. 11; Georgia State Exposition at Macon, no fixed date.

December, Open Golf Tournament at Augusta, no fixed date.

Government

Constitution. Georgia adopted its eighth constitution in 1945. Earlier ones were adopted in 1777, 1789, 1798, 1861, 1865, 1868, and 1877. Important changes in the 1945 constitution included creating the office of lieutenant governor, and abolishing the governor's power to veto constitutional proposals.

To amend the constitution, two thirds of the legislature must vote in favor of an amendment, and more than half of the voters in Georgia must approve the amendment.

Executive. The governor is elected for a four-year term. He cannot succeed himself, but may be elected again after another governor has been in office. As director of the budget, the governor has extensive control over state finances. He appoints the members of state commissions, and several other state officers.

Other elected state officials include the lieutenant

governor, secretary of state, attorney general, state school superintendent, treasurer, comptroller general, commissioner of agriculture, and commissioner of labor. All serve four-year terms. The voters also elect the five members of the Public Service Commission.

Legislature. The senate has 54 members, one from each of the state's senatorial districts. The house of representatives has 205 members who represent Georgia's 159 counties in the following ratio: 3 representatives for each of the 8 counties with the largest populations; 2 representatives for each of the next 30 largest counties; and one for each of the 121 remaining counties.

The members of both houses serve two-year terms. The legislature meets every year for a regular 40-day session beginning on the second Monday in January.

Courts of Georgia include the supreme court, the court of appeals, 37 superior courts, city courts, county courts, juvenile courts, courts of ordinary (probate courts), and justices of the peace. All judges are elected by popular vote except county-court judges and some city-court judges. The governor appoints these judges, with the approval of the senate. The supreme court has a chief justice and six associate justices. Juvenile-court, supreme-court, and court-of-appeals justices serve six-year terms. Judges of the superior courts, courts of ordinary, and justices of the peace serve four-year terms.

Local Government is based on the county. Boards of commissioners administer 149 counties. The number of commissioners in each county varies from one to eight. In the 10 counties that do not have boards of commissioners, an *ordinary* handles county business. The ordinary corresponds to a probate judge in other states. Most cities and towns have a mayor-council form of government, but some cities have city managers.

Taxation. Georgia's chief source of income is from general sales taxes and state income taxes from individuals and corporations. The state also has sales taxes on cigarettes, gasoline, and liquor.

Politics. Georgia is a stronghold of the Democratic party. The state has never cast its electoral vote for a Republican candidate in a national election. For the state's voting record in presidential elections since 1804, see ELECTORAL COLLEGE (table).

The Democrats also dominate local elections, except for several Republican counties in north-central and northeastern Georgia. The only political contests have been between rival factions of the Democratic party. Usually the Republican party does not even nominate candidates for office, so winners of Democratic primary elections are almost always unopposed for office.

The county-unit rule regulates Georgia's primary elections, in which the voters nominate candidates for state offices and U.S. Senator. Candidates are nominated by county votes, and whoever has the most votes in each county gets all that county's votes. Each county receives twice as many unit votes as it has state representatives. No county has fewer than two unit votes. Therefore, the three smallest counties, Echols, Glascock, and Quitman, which combined have less than one three-hundredth of the population, have as much power together as Fulton County, with one fourth of the population. Georgia is the only state with such a system.

National Defense. The U.S. Army has four forts in Georgia: Fort Benning, at Columbus; Fort Gordon, at Augusta; Fort McPherson, at Atlanta; and Fort Stewart,



Devaney

Georgia's State Capitol, in Atlanta, was built of limestone and modeled after the national capitol. It was completed in 1889.

at Hinesville. Fort Benning is one of the largest infantry posts in the world. The army maintains the Atlanta General Depot at Forest Park. See FORT BENNING; FORT GORDON; FORT MCPHERSON.

History

Indian Days. Indians were the first people to live in what is now Georgia. Some of these early Indians built large mounds (see MOUND BUILDERS). They left relics that show their skill in arts and crafts. Before white men came to the region, the Creek Indians settled in the south, and the Cherokee built villages in the Highlands.

Exploration. Hernando de Soto was probably the first white man to visit the Georgia territory. He crossed the region in 1540, on his way from Florida to the Mississippi River. French explorers established a small settlement on the St. Johns River in 1564. This action angered King Philip II of Spain, who wished to claim the territory for his country. In 1565, he sent Pedro Menéndez de Avilés to build forts along Georgia's coast. Menéndez claimed what is now the southeastern United States for Spain. England also claimed this region, which was part of the original Carolina grant made by King Charles I to Sir Robert Heath in 1629. The English built a fort on the Altamaha River in 1721, but its expense caused them to abandon it in 1727.

Colonial Period. In 1732, King George II of England granted a charter to a corporation called "Trustees for establishing the Colony of Georgia in America." Spain, which had already claimed the territory, protested to England, but was ignored. In 1730, plans for the colony had been made by James Oglethorpe, a member of

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parliament, and Lord John Perceval, a noted English philanthropist. Oglethorpe had thought of sending imprisoned or released debtors to the colony. This idea was abandoned because Oglethorpe lost interest in it, and few debtors were accepted in Georgia.

Oglethorpe sailed with the first band of 114 colonists in November, 1732. They arrived at Yamacraw Bluff, the site of present-day Savannah, on Feb. 12, 1733. During the 20 years that the trustees controlled Georgia, they sent in more than 1,810 colonists, many of them Germans from Salzburg. More than 1,000 other settlers came to the colony at their own expense.

During this period, many English ships smuggled merchandise to Spanish colonies in Florida and the West Indies. This illegal trading, and the controversy over who was to control what is now the southeastern United States, led to war between England and Spain in 1740. Oglethorpe defeated a Spanish force from Florida at the Battle of Bloody Marsh on St. Simons Island in 1742, and ended the fighting in America.

Until this time, slavery and the importation or sale of liquor had been forbidden in Georgia. The trustees bowed to the protests of the colonists, and permitted liquor in the colony in 1742, and slaves in 1749. The trustees in 1751 asked the British Parliament for money to help administer Georgia. Parliament refused, because Georgia had already received more money than any other colony. The trustees gave up their charter in 1752, and King George reorganized the colony as a royal province in 1754.

If left to itself, Georgia might have continued quietly under this rule. But the people were affected by the desire for independence in the other colonies. Three Georgians, Button Gwinnett, Lyman Hall, and George Walton, signed the Declaration of Independence in 1776, at Philadelphia. The colony ratified the Articles of Confederation in 1778. During the Revolutionary War, Georgia did not become a major battleground until 1778. However, Georgia colonists clashed with the

English in many small engagements. British troops captured Savannah in December, 1778, and by the end of 1779 had seized all Georgia except Wilkes County.

Early Statehood. On Jan. 2, 1788, Georgia became the fourth state to ratify the United States Constitution.

In 1795, land companies that wished to buy western Georgia lands and sell them at a profit, bribed corrupt state legislators. The legislature sold the companies most of what is now Alabama and Mississippi, which Georgia claimed as part of the state. This deal came to be known as the Yazoo Fraud, because the Yazoo River ran through part of the territory sold. In 1796, angry Georgians elected a new legislature, which declared the sale illegal. However, the Supreme Court of the United States ruled in 1810 that the sale was legal.

In 1802, Georgia had sold the federal government its lands west of the Chattahoochee River. The government promised to settle the claims of the land companies. It also agreed to remove the Indians gradually from western Georgia so the land could be opened to white settlers. In 1814, Congress authorized a payment of over \$4,200,000 to the land companies. In 1826, the Creek sold the last of their land in Georgia to the government and moved to Arkansas Territory. Twelve years later, federal troops rounded up the Cherokee and forced them to leave northern Georgia. They went to Indian Territory, in what is now Oklahoma.

War and Reconstruction. Many Georgians who depended upon slave labor felt that the federal government had no right to prohibit slavery in a territory, or to refuse a slave state admission to the Union. Many Georgians wanted their state to secede from the Union. Alexander H. Stephens, a Georgia U.S. Congressman who later became Vice-President of the Confederacy, led the opposition to secession. In spite of his efforts, Georgia seceded on Jan. 19, 1861.

The first great battle of the Civil War fought on Georgia soil was at Chickamauga, on Sept. 19 and 20, 1863 (see CIVIL WAR [Chickamauga]). General William T. Sherman opened an extensive campaign in northern Georgia the following spring, and occupied Atlanta in September. Sherman's troops set fire to the city in November, and started their march to the sea. The Union forces carried few supplies with them. They lived off the land while cutting a 60-mile-wide path from Atlanta to Savannah. The troops looted the countryside, stealing food, livestock, and other property from the plantations and towns. Sherman ordered his troops to destroy all public buildings, mills, railroads, and manufacturing buildings. They destroyed an estimated \$1,000,000 in property.

Hard times followed the war. Congress set up a military rule in Georgia, and carpetbaggers gained control of the government. Some government officials stole public money (see CARPETBAGGER; RECONSTRUCTION). Georgia was readmitted to the Union in 1868, but expelled in 1869 because it rejected Amendment 15, the right of citizens to vote regardless of race. In 1870, it was again admitted after ratifying the amendment.

Progress as a State. After re-entering the Union, the state directed its efforts toward increasing manufacturing. During the early 1900's, farmers began to raise less cotton in order to avoid the economic dangers of planting only one crop (see AGRICULTURE [Kinds]). During the period from 1900 to 1907, Georgia's corn acreage

RED-LETTER DATES IN GEORGIA

- 1540 The Spanish explorer De Soto passed through Georgia.
- 1733 James Oglethorpe and his settlers arrived.
- 1740 Georgia aided the British in war against Spain.
- 1751 The first colonial assembly met at Savannah.
- 1754 Georgia became a British Crown colony.
- 1777 Georgia adopted its first constitution.
- 1778 England captured Savannah in the Revolutionary War.
- 1788 Georgia entered the Union on January 2 as the 4th state.
- 1793 Eli Whitney invented the cotton gin near Savannah.
- 1838 The government forced the Cherokee Indians to leave Georgia for the Indian Territory.
- 1861 Georgia seceded from the Union.
- 1863 Confederate troops defeated Union forces in the Battle of Chickamauga, in northwestern Georgia.
- 1864 General Sherman burned Atlanta.
- 1870 Georgia was readmitted to the Union.
- 1922 Mrs. Rebecca L. Felton became the first woman U.S. Senator.
- 1943 Georgia became the first state to allow 18-year-olds to vote.
- 1945 Georgia adopted its present constitution.
- 1956 Georgia adopted a new state flag.

HISTORIC GEORGIA



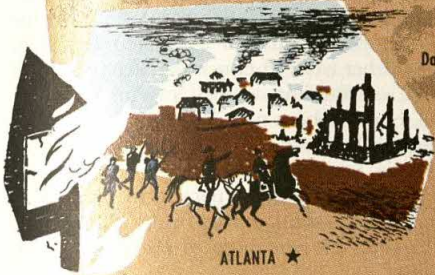
The First Gold Rush in the United States was touched off when prospectors discovered deposits at Dahlonega in 1828.

Dahlonega



The First Painless Operation was performed by Dr. Crawford W. Long at Jefferson in 1842. He used sulfuric ether as an anesthetic.

• Jefferson



ATLANTA ★

Atlanta Was Burned by General William T. Sherman on his march to the sea during the Civil War.

The First Girl Scout Troop in America was organized in 1912 by Mrs. Juliette Low of Savannah.

• Warm Springs



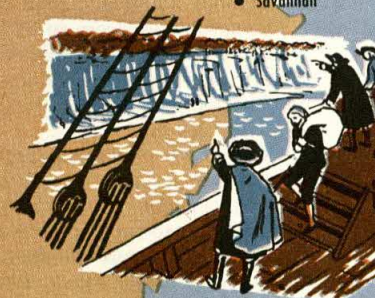
Warm Springs Foundation, which cares for victims of infantile paralysis, was founded by Franklin D. Roosevelt in 1927.

The First White Settlement in Georgia was founded in 1733 at Savannah by James Oglethorpe, a member of the British Parliament.

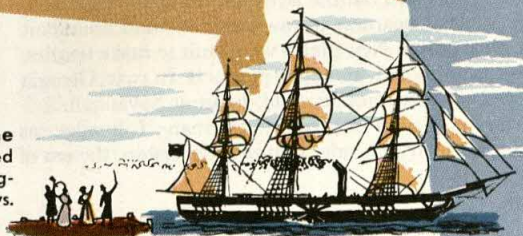
• Savannah



Eli Whitney invented the cotton gin near Savannah in 1793. The invention helped make cotton the South's most important crop.



The First Steamship to Cross the Atlantic, the S.S. Savannah, traveled from Savannah, Ga., to Liverpool, England, in 1819. The voyage lasted 29 days.



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increased by one third, and tobacco became an important farm crop.

During World War I, more than 93,000 Georgians served in the armed forces. Increased farm prices and more factories brought new prosperity to the state. In 1922, Georgia's Rebecca L. Felton became the first woman U.S. Senator. She was appointed by Governor Thomas W. Hardwick to serve the final two days of the term of Senator Thomas E. Watson, who died in office. She was succeeded by Walter F. George.

Depression and Recovery. During the depression of the 1930's, the federal government financed construction of highways, public buildings, and sewer and drainage systems in Georgia. In 1931, the state government, under Governor Richard B. Russell, grouped 17 colleges in a university system to promote economy and efficiency. The people elected Eugene Talmadge governor in 1932 and 1934. E. D. Rivers was elected governor in 1936 and 1938. Eugene Talmadge became governor for the third time in 1940. The demands of World War II caused a rapid increase in manufacturing and farm prosperity. More than 300,000 Georgians served in the armed forces. Ellis Arnall was elected governor in 1942. Arnall led a commission of 23 members in writing a new state constitution that was adopted in 1945.

In Georgia's 1946 Democratic primary election, James V. Carmichael, a manufacturer, received 314,421 votes to Eugene Talmadge's 305,777 votes. Write-in voters gave Eugene Talmadge's son, Herman Talmadge, 675 votes and D. T. Bowers, a salesman, 637 votes. Because of Georgia's county-unit system, Eugene Talmadge won the primary even though he received fewer votes than Carmichael. Eugene Talmadge died before he could begin his term, and the legislature chose his son, Herman, as governor. This was possible because the constitution did not say what should be done if a governor-elect died.

Governor Arnall opposed the action of the legislature. He said he would not permit Talmadge to succeed him. But Talmadge's supporters changed the locks on Arnall's office doors, and used state troopers to bar him from the governor's mansion. Arnall resigned after Melvin E. Thompson was sworn in as lieutenant governor. The Georgia Supreme Court overruled the action of the legislature after Talmadge had served only 63 days as governor. Thompson then became acting governor until the election of 1948.

Recent Developments. The people elected Herman Talmadge governor in 1948 to serve the remainder of his father's term, and again in 1950. During his administration (1948-1955), the state spent more than \$450,000,000 for schools. All previous administrations had spent only \$408,000,000 for education. Talmadge's administration also provided more roads and hospitals, and increased the amount of state pensions. Talmadge won acclaim for his efforts in attracting industry to the state. He pointed out the advantages of a Georgia location, such as nearness to raw materials and abundant electrical power. New plants were built to make textiles, paper, paperboard, and other products. In 1952, Georgia opened to commerce its state docks at Savannah.

Marvin Griffin succeeded Herman Talmadge as governor in 1955. Under Griffin's leadership, the era of

prosperity continued. The state improved school buildings, and increased teachers' salaries. Griffin also encouraged industries to build plants in Georgia.

Famous Georgians

Separate biographies are listed under the heading Georgia in the BIOGRAPHY section of the READING AND STUDY GUIDE. Alexander H. Stephens, who served as Vice-President of the Confederate States of America, represents Georgia in Statuary Hall in the Capitol in Washington, D. C. The following short biographies include other noted persons who were born in Georgia or did important work there.

Berry, Martha McChesney (1866-1942), founded the Berry School for needy children at Mount Berry. In 1932, because of her work in education, she was voted one of the 12 outstanding women in America in a national poll. She was born near Rome.

Brown, Joseph Emerson (1821-1894), served as governor of Georgia four times. As governor during the Civil War, he made important reforms in the militia system. Brown, a Democrat, served in the U.S. Senate from 1880 to 1891. He was born in Pickens District, South Carolina.

Clarke, Elijah (1733-1799), won the Battle of Kettle Creek as a colonel in the Revolutionary War. Later he fought Indians and speculated in Georgia's western lands. He was born in Edgecombe County, North Carolina.

George, Walter F. (1878-1957), a Democrat, served as U.S. Senator for 34 years, from 1922 to 1956, and as chairman of the Senate Foreign Relations Committee. In 1956, President Dwight D. Eisenhower appointed him personal ambassador to the North Atlantic Treaty Organization (NATO). George was born near Preston.

Gordon, John Brown (1832-1904), a Confederate general, commanded troops in several Civil War battles. He was a Democrat, and served in the U.S. Senate from 1873 to 1880. He was governor of Georgia from 1886 to 1890. Gordon was born in Upson County.

Herty, Charles Holmes (1867-1938), discovered many industrial uses for farm products of the South. He developed a new method of getting turpentine from pine trees without injuring the trees. He also developed processes that made it possible to use young pine trees in the manufacture of newsprint. Herty was born in Milledgeville.

Milledge, John (1757-1818), became attorney general of Georgia in 1780, and served in the U.S. House of Representatives from 1792 to 1802. He was governor of Georgia from 1802 to 1806, and served in the U.S. Senate from 1806 to 1809. Milledge donated the present site of the University of Georgia. The city of Milledgeville was named in his honor. He was born in Savannah.

Reynolds, John (1713-1788), was the first royal governor of Georgia. He served from 1754 to 1757. He then returned to the British Navy and reached the rank of admiral before his death in London.

Smith, Hoke (1855-1931), was a journalist, lawyer, and a leader in the Democratic party. From 1893 to 1895, he served as Secretary of the Interior in President Grover Cleveland's Cabinet. Smith was governor of Georgia from 1907 to 1909. He served in the U.S. Senate from 1911 to 1921. Smith was born in Newton, N.C.

Talmadge, Eugene (1884-1946), a Democrat, was elected governor of Georgia four times. He served as state commissioner of agriculture before being elected for the

first time in 1933. Talmadge died before he could serve his fourth term. He was born in Forsyth.

Talmadge, Herman (1913-), the son of Eugene Talmadge, was born in McRae. When his father, the governor-elect, died in 1946, the legislature chose Herman governor. Like his father, he was a Democrat. The voters elected him governor in 1948 for two years of an unexpired term, and in 1950 for a four-year term. He was elected to the U.S. Senate in 1956.

Toombs, Robert (1810-1885), a lawyer, orator, and statesman, served in the Georgia legislature, the U.S. House of Representatives, and the U.S. Senate. President Jefferson Davis appointed him Confederate Secretary of State, but he resigned to become a brigadier general in the Army of Northern Virginia. After the Civil War, he practiced law and led a movement to overthrow the Reconstruction government. He was born in Wilkes County. ALBERT B. SAYE, Critically reviewed by MERLE PRUNTY, JR.

Related Articles in WORLD BOOK include:

BIOGRAPHIES

An alphabetical list of biographies relating to Georgia appears under the heading Georgia in the BIOGRAPHY section of the READING AND STUDY GUIDE.

CITIES

Albany	Brunswick	Milledgeville
Athens	Columbus	Savannah
Atlanta	Macon	Thomasville
Augusta		

HISTORY

Cherokee Indians	De Soto, Hernando
Civil War	Mound Builders
Colonial Life in America	Oglethorpe, James Edward
Confederate States of America	Revolutionary War in America
Creek Indians	Stephens, Alexander Hamilton
	Warm Springs Foundation, Georgia

PHYSICAL FEATURES

Appalachian Mountains	Ocmulgee National Monument
Blue Ridge Mountains	Okefenokee Swamp
Chattahoochee River	Piedmont Region
Fall Line	Savannah River
Jekyll Island	Stone Mountain

PRODUCTS

For Georgia's rank among the states in production, see the following articles:

Building Stone	Granite	Nut	Textile
Chicken	Lumber	Peanut	Tobacco
Cotton	Marble	Pecan	Watermelon
Forest and Forest Products	Muskmelon	Shrimp	

UNIVERSITIES AND COLLEGES

Georgia's universities and colleges which have separate articles are listed in a table in the *Education* section of this article.

Outline

I. The Land and Its Resources

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| A. Location and Size | E. Rivers, Waterfalls, and Lakes |
| B. Land Regions | F. Natural Resources |
| C. Coast Line | G. Climate |
| D. Mountains | |

II. Life of the People

- | | | |
|---------------|-----------|-----------------|
| A. The People | B. Cities | C. Country Life |
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III. Work of the People

- | | |
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| A. Agriculture | E. Fishing Industry |
| B. Manufacturing | F. Electric Power |
| C. Mining | G. Transportation |
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GEORGIA, UNIVERSITY OF

IV. Education

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| A. Schools | B. Libraries | C. Museums |
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V. The Arts

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| A. Architecture | C. Painting and Sculpture |
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VI. Interesting Places to Visit

VII. Government

VIII. History

IX. Famous Georgians

Questions

Why did James Oglethorpe want to establish the Georgia colony?

What is the county-unit system? How does it affect the people of Georgia's cities and farm areas?

Who was the first woman U.S. Senator?

What new uses for Georgia's pine trees did Charles Holmes Herty discover?

Where did the first gold rush in the nation occur? When?

What two U.S. Presidents often vacationed in Georgia?

What Georgian became Vice-President of the Confederacy?

How did Georgia farmers ruin much of their land before the 1930's?

How does Georgia spend most of its income?

In what city is the first state-chartered university?

Books for Young Readers

BAILEY, BERNADINE F. *Picture Book of Georgia*. Whitman, 1953.

MAYNARD, LOUISE, and AULTMAN, RUTH W. *Our Georgia*. Steck, 1950. Simple stories giving historical information.

PARKS, AILEEN W. *James Oglethorpe*. Bobbs, 1958.

SUDDETH, RUTH E., and others. *Empire Builders of Georgia*. Steck, 1957. A history text.

Books for Older Readers

BONNER, JAMES C. *The Georgia Story*. Harlow, 1958. A high school and junior college text.

BRYAN, T. CONN. *Confederate Georgia*. Univ. of Georgia Press, 1953.

CATE, MARGARET D. *Early Days of Coastal Georgia*. Univ. of Georgia Press, 1955. Photographs and text.

COULTER, E. MERTON. *Georgia: A Short History*. Rev. & enl. ed. Univ. of North Carolina Press, 1960.

Georgia: A Guide to Its Towns and Countryside. Rev. & enl. ed. Tupper, 1954.

GOSNELL, CULLEN B., and ANDERSON, C. D. *The Government and Administration of Georgia*. Crowell, 1956.

MEADOWS, JOHN C. *Modern Georgia*. Rev. ed. Univ. of Georgia Press, 1951.

PERKERSON, MEDORA F. *White Columns in Georgia*. Rinehart, 1952. Georgia's history and its famous old homes.

SAYE, ALBERT B. *Georgia Government and History*. Row, Peterson, 1957. A high school text.

GEORGIA, UNIVERSITY OF, is a coeducational state university at Athens, Ga. It became one of the nation's first state-chartered universities in 1785, and opened in 1801. It has colleges and schools of law, business administration, journalism, education, pharmacy, agriculture, forestry, home economics, arts and sciences, veterinary medicine, and a graduate school. It offers all the usual university degrees, and is a part of the University System of Georgia. An adult education center opened on the campus in 1957. Red and black are the school colors, and the athletic teams are called the Bulldogs. One of the well-known University of Georgia songs is "Glory to Ole Georgia." For enrollment, see UNIVERSITIES (table).

O. C. ADERHOLD



Virginia State Chamber of Commerce

Georgian Architecture is the style of the beautiful dark red brick Westover mansion near Richmond, Va. It was completed in 1735 by the famous Virginian, Colonel William Byrd II. During the Civil War, Union soldiers heavily damaged the building. The house has been restored, however, and now serves as a museum.

GEORGIA INSTITUTE OF TECHNOLOGY is a state-controlled coeducational university at Atlanta, Ga. It ranks as the largest engineering college in the South. The schools of engineering are: aeronautical, ceramic, chemical, civil, electrical, industrial, mechanical, and textile. It also has schools of architecture, physics, mathematics, chemistry, and industrial management; a graduate division; an engineering extension division; and a state engineering experiment station. Courses lead to bachelor's, master's, and doctor's degrees. The Price Gilbert Library is an outstanding example of contemporary architecture. The Institute was founded in 1885. "Rambling Wreck from Georgia Tech" is a popular school song. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

E. D. HARRISON

"GEORGIA PEACH." See COBB, "Ty," TYRUS RAYMOND.

GEORGIA SOUTHERN COLLEGE is a state-controlled teacher education institution at Collegeboro, Ga., a suburb of Statesboro. It is a branch of the University System of Georgia. Graduates receive a B.S. degree in education, or A.B. or B.S. degrees. The institution began as a high school in 1908. It began offering college work in 1924. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

ZACH S. HENDERSON

GEORGIA STATE COLLEGE FOR WOMEN is a liberal arts and professional school for women at Milledgeville, Ga. It was established in 1889 as a teacher-training school, but became a regular four-year college in 1917. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GEORGIA STATE COLLEGE OF BUSINESS ADMINISTRATION is in Atlanta. Founded as part of Georgia Institute of Technology in 1914, it became an independent school under its present name in 1955. The first Student Credit Union in any college was organized there in 1932. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GEORGIA WARM SPRINGS FOUNDATION. See WARM SPRINGS FOUNDATION, GEORGIA.

GEORGIAN ARCHITECTURE is the building style used in England and the English colonies during the 1700's and early 1800's. The style takes its name from

the English kings who reigned during this period: George I, II, and III.

Georgian architecture has *symmetry*, or balance, in design, and restrained but bold ornament based on classic forms. It makes extensive use of brick and stone. Most small Georgian houses are square or rectangular in shape, and are built around a central stair-hall. Georgian architects often decorated the rooms with large panels and large, richly ornamented, rectangular fireplaces. The builders often designed imposing main doors, using a projecting hood or a porch with columns. Ornamental cornices appear around the edges of the roofs, and chimneys are distributed equally on the two sides of the building.

Larger houses built in the Georgian style frequently have a central block with symmetrical wings. Many imposing churches, noted for their beautiful towers, were also built in this style.

Well-known buildings in English Georgian style include the church of Saint Martin-in-the-Fields in London (see LONDON [picture]); and the fine houses, squares, and terraces of Bath, a fashionable resort of the 1700's. Georgian architecture influenced American colonial building styles, including homes and churches. Southern mansions built just before the Civil War are sometimes wrongly called Georgian.

BERNARD LEMANN

GEORGIAN BAY, a northeastern arm of Lake Huron, lies entirely within the Canadian province of Ontario. The bay is about 120 miles long and 50 miles wide, or about half the size of the rest of the lake. Formerly called Lake Manitoulin, Georgian Bay is almost entirely shut off from the main part of Lake Huron. The Bruce Peninsula cuts off the bay on the east, and a chain of islands lies to the west. North Channel separates the largest of these islands, Manitoulin, from the mainland. This channel, bordered by rocky cliffs, serves as the main ship passage between the lake and the bay. Its waters are more than 300 feet deep in many places. For location, see ONTARIO (color map).

More than 30,000 small islands dot the waters of Georgian Bay. Summer homes and hotels have been built on many of these islands, and thousands of tourists

visit the shore resorts in the summer. In 1929, the Canadian government set aside thirty of these islands as a national park area. See CANADA (National Parks).

Rivers that empty into the bay include the French, the Muskoka, and the Severn. Small boats can go from Georgian Bay to the Bay of Quinte on Lake Ontario. They pass from Georgian Bay up the Severn River to Lake Simcoe, then by way of the Trent Canal (built in 1918) to the Talbot River, and through a chain of lakes to the Trent River, which empties into the Bay of Quinte. The east bank of Georgian Bay is low and rocky. On the north, high cliffs line the shore. A heavily wooded region surrounds the lake.

BOSTWICK H. KETCHUM

GEORGIAN BAY ISLANDS NATIONAL PARK.

See CANADA (National Parks).

GEORGIAN COURT COLLEGE is a liberal arts college for women at Lakewood, N.J. It is a Roman Catholic school, operated by the Sisters of Mercy. It offers B.A. and B.S. degrees. The college was founded in 1908. For enrollment, see UNIVERSITIES AND COLLEGES (table).

GEOTROPISM. See TROPISM.

GERAGHTY, AGNES. See SWIMMING (Famous Swimmers).

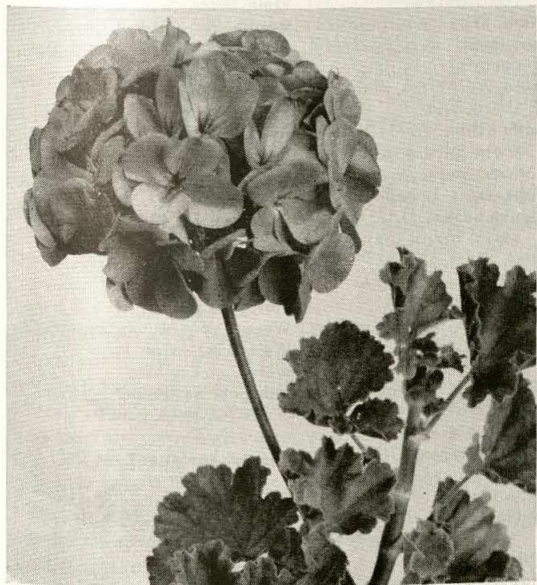
GERANIUM is a plant native to South Africa and Australia, but widely grown in the United States and Canada. Wild geraniums are popularly called *crane's-bill* and *heron's-bill*, because of the shape of their fruit. Cultivated and indoor geraniums are varieties of another group, commonly called *stork's-bill*.

Many forms of geraniums have been developed. They vary in the size and color of their flowers and in the markings and texture of their leaves. In California and places with a similar climate, the plants may grow to the size of a bush. Common groups are *ivy*; *scented leaf*; *zonal*, or *horseshoe*; and *Lady Washington*, or *showy pelargonium*. The ivy-leaved types are favorites for window boxes.

Geraniums are widely grown in homes and gardens

The Geranium Has Attractive Leaves that usually are shaped like a heart. The red, white, or pink flowers grow in ball-like clusters at the end of the plant stems.

W. Atlee Burpee



GÉRICAUT, THÉODORE

because they adapt themselves readily. They grow easily from *slips*, or stems cut from the plants. Slips for summer blooming are taken from plants in the early spring, and those for winter flowering are taken in fall. Geraniums that are potted for winter growth must be cut back and shaped. This prevents the plants from becoming too tall and ragged looking. The plants do not thrive in rich soil. They must have plenty of sunshine and enough water to keep the roots moist.

Cooks often use leaves of the rose geranium to flavor jellies. A wild geranium, called *herb Robert* or *red robin*, has been used in medicine. Another wild geranium, known as *alfilaria* or *red-stem filaree*, is grown for forage in western and southwestern United States.

Scientific Classification. Geraniums make up the family *Geraniaceae*. Cultivated forms belong to the genus *Pelargonium*. Ivy geranium is genus *Pelargonium*, species *pellatum*, rose geranium is *P. graveolens*, and Lady Washington is *P. domesticum*. The herb Robert is *Geranium robertianum*. *Alfilaria* is *Erodium cicutarium*.

GEORGE A. BEACH

See also FLOWER (color pictures, Enjoying Flowers Indoors; Flowers of the Woodland).

GERIATRICS, *JER ih AT riks*, is a branch of medical science which has to do with old age and its diseases. *Geriatrics* comes from the Greek word *geron*, meaning *old man*, or *geras*, meaning *old age*; and *iatrikos*, meaning *healing*. This branch of medicine includes the diagnosis, treatment, and medical management of the older patient.

There are three scientific approaches to the problems of the aging. In *gerontology*, the biologist studies the aging process. In *social gerontology*, the sociologist attempts to help older people adapt to a changing world. For example, older persons often find it difficult to adjust to a life of retirement. Increasing life expectancy has increased the number of aged and made the social and economic problems of aging more acute. In *geriatrics*, the medical scientist, or physician, studies aging and aged patients' particular physiology. He also should have knowledge of the two other fields as he tries to maintain the best possible physical and mental health in the aging.

Attention to the personal and social problems of older persons is increasing. Research and training are being supported by medical schools; by the Department of Health, Education, and Welfare; and by various foundations, insurance companies, chemical, and pharmaceutical firms.

JOSEPH T. FREEMAN

GÉRICAUT, ZHAY ree KOH, THÉODORE (1791-1824), a French artist, painted vivid pictures of horses, and of events of his day. Géricault died at the age of 32, but he had produced in only 15 years a tremendous number of drawings, studies, and paintings. In his first public exhibit in 1812, he showed a violent painting of a cavalry officer on his rearing horse. In 1819, Géricault painted his most famous picture, *The Raft of the Medusa*, based on an actual event of a scandalous sea tragedy in 1816. He treated the subject just as he would have treated an historic painting. He visited England in 1820, and made many pictures of horses. His last works were a series of portraits of insane people. Géricault died as the result of a riding accident. He was born in Rouen. His full name was JEAN LOUIS ANDRÉ THÉODORE GÉRICAUT.

ROBERT GOLDWATER

GERM

GERM, in biology, is a *microorganism*, or a tiny living thing that can be seen only under a microscope. Most persons use the term *germ* to mean disease-producing bacteria. But many kinds of germs do not cause disease. See also BACTERIA; DISEASE (Infectious Diseases).

GERM CELL. Each human being develops from a tiny fertilized egg. In this egg there are two sets of threadlike bodies called *chromosomes*, 23 from each parent (see CHROMOSOME). Chromosomes contain thousands of *genes*, which are substances concerned with heredity (see GENE). When the egg is fertilized, it divides repeatedly to form billions of cells with special functions. Those whose function it is to give rise to eggs or sperms are the *germ cells*. They produce eggs in the ovaries, or sperms in the testes by dividing.

The germ cells are always set aside in each new individual to become reproductive tissue. These groups of cells make up the *germ plasm*. All other cells become *somatic cells*. They make up the *soma*, or protoplasm of body cells. The germ plasm holds substances necessary to produce new individuals and has no other function. The theory of distinguishing between germ plasm and the soma was introduced in the 1880's by August Weismann (see WEISMANN, AUGUST).

G. W. BEADLE

See also CELL; FERTILIZATION; REPRODUCTION.

GERM THEORY. See DISEASE (Infectious Diseases).

GERM WARFARE, also called *biological warfare*, is the military use of harmful microorganisms as weapons. Such biological weapons have not been used by modern armies. However, all nations realize that ways may be found to develop and use biological warfare in addition to, or in place of, bullets, high-explosive shells, and nuclear weapons. There have been occasional unorganized attempts to exploit disease in past wars. For example, soldiers sometimes threw bodies of plague victims over walls into besieged cities or into wells. During the French and Indian Wars, blankets used by smallpox victims were given to Indians in the hope that they would contract the disease.

Sickness from natural causes has been a scourge to armies throughout history. It contributed to Napoleon's defeat in his Russian campaign, when he failed to care for the medical needs of his soldiers. In fact, before World War II, the United States armies suffered more deaths from disease than from battle casualties. Even then, time lost because of disease was four times greater than that lost because of battle wounds.

People have called biological warfare "public health in reverse." Public health workers seek to combat disease. Biological warfare seeks to promote sickness for the enemy. But the development of biological warfare means that defenses against it must also be provided.

Nobody knows exactly how organisms that cause diseases in man, animals, and plants might be used successfully for military purposes. Although a tiny amount of such a material might easily contain a billion death-dealing doses, there is no conceivable way to realize this potential. The substance must be produced artificially in large quantities. The user must find a way to spread it within a target area while it is still potent. This means that favorable conditions of light, moisture, and air movement must also exist. But if the user is to survive, he must develop protective measures and materials.

Persons interested in developing germ warfare believe that it may decrease, rather than increase, the horror of war. They believe that disease agents might be found that would make the enemy too sick to fight, rather than kill him or innocent civilians. They also believe that it would reduce the cost of war. It would leave buildings and supplies untouched, thus saving the cost of rehabilitation and rebuilding.

HARLAN N. WORTHLEY

GERMAN EAST AFRICA. See TANGANYIKA.

GERMAN EMPIRE. See GERMANY (History).

GERMAN LANGUAGE is the official language of Germany and Austria, and one of the official languages of Switzerland. About 100,000,000 persons speak German as their native tongue. This makes it the fourth most widely used European language, following English, Russian, and Spanish. Most German-speaking people live in Europe.

German and English have many close connections. Both are related to an older Germanic language once used by the tribes of north-central Europe. English has a number of words taken directly from German, such as *kindergarten* and *poodle*. Other words include such foods as *kohlrabi* and *sauerkraut*, and such terms as *blitzkrieg*, *plunder*, and *yodel*. The two languages have some almost identical words, including *hand* and *Hand*, *light* and *Licht*, and *swim* and *schwimmen*. But some look-alikes do not mean the same thing. For example, *wo* means *where*, although it looks like *who*, and *wer* means *who*, although it looks like *where*.

Characteristics. In the German language, all nouns are capitalized. Many words are formed by adding together two or more words or parts of words. For example, one way of saying *streetcar stop* is *Strassenbahnhaltestelle*. This tongue-twister includes the word for *streetcar*, *Strassenbahn* (which comes from the words for *street* and

SOME COMMON GERMAN TERMS

auf Wiedersehen , <i>owf VEE dehr zayn</i> , good-by	Herr , <i>hehr</i> , gentleman, or Mr.
Autobahn , <i>OW toh bahn</i> , expressway	heute , <i>HOY tuh</i> , today
Bahnhof , <i>BAHN hawf</i> , railroad station	hier , <i>heer</i> , here
Berg , <i>behr</i> , mountain	ja , <i>yah</i> , yes
bestimmt , <i>buh SHTIHMT</i> , certainly	jawohl , <i>yah VOHL</i> , yes, surely
bitte , <i>BIHT tuh</i> , please, or thank you	klein , <i>kline</i> , little
bitte schön , <i>BIHT tuh shayn</i> , please, or you're welcome	Knabe , <i>KNAH buh</i> , boy
Brot , <i>broht</i> , bread	Mädchen , <i>MAYD khuhn</i> , girl
danke schön , <i>DAHN kuh shayn</i> , many thanks	Mann , <i>mahn</i> , man
dort , <i>dawrt</i> , there	Milch , <i>mihlkh</i> , milk
Eisenbahn , <i>EYE zuhn bahn</i> , railroad	nein , <i>nine</i> , no
Frau , <i>frow</i> , woman, or Mrs.	nein danke , <i>NINE dahn kuh</i> , no, thank you
Fräulein , <i>FROY line</i> , young lady, or Miss	rot , <i>roht</i> , red
Geld , <i>gehlt</i> , money	schwarz , <i>shvarts</i> , black
gross , <i>grohs</i> , large	sprechen sie Deutsch?
gut , <i>goot</i> , good	SHPREHKH uhn zee
guten Morgen , <i>GOOT uhn MAWR guhn</i> , good morning	DOYCH , do you speak German?
guten Tag , <i>GOOT uhn TAHG</i> , good day, how do you do?	viel , <i>feel</i> , much
Haus , <i>hows</i> , house	Wasser , <i>VAH suhr</i> , water
	Wein , <i>vine</i> , wine
	weiss , <i>vice</i> , white
	wie geht es ihnen? <i>vee GAYT ehs EE nuhn</i> , how are you?
	wievie! kostet es? <i>vee feel KOHS teht ehs</i> , how much does it cost?
	wievie! Uhr ist es? <i>vee feel OOR ihst ehs</i> , what time is it?
	Wurst , <i>voorst</i> , sausage

track), and the word for *stopping-place*, *Haltestelle* (made up of the words for *stop* and *place*).

Grammar. Nouns may be masculine, feminine, or neuter, but the nature of the thing may not indicate its gender. For example, *pencil* (*der Bleistift*) is masculine, *pen* (*die Feder*) is feminine, and *paper* (*das Papier*) is neuter. Similarly, *donkey* (*der Esel*) is masculine, *mouse* (*die Maus*) is feminine, and *horse* (*das Pferd*) is neuter. Several word endings automatically make words neuter. For example, the endings *-chen* and *-lein* make *Mädchen*, (girl) and *Fräulein* (young lady or miss) neuter nouns.

Word Order probably causes more difficulty for students than does any other aspect of German. The sentence *At two o'clock we came home in a taxicab* would have this arrangement in German: *At two o'clock came we in a taxicab home*. Word placement follows fairly definite rules. The verb normally comes in the second position in the sentence. If the subject does not begin the sentence, it immediately follows the verb, as in the example above. But in a dependent clause, the verb comes at the very end, as: *Our parents were not angry, although we at two o'clock in a taxicab returned*.

Pronunciation. German pronunciation follows German spelling more closely than English pronunciation follows English spelling. German has few letters pronounced in more than one way, and almost no silent letters. Vowels and consonants are pronounced with more force and breath than in English. The language contains a few sounds unfamiliar to English-speaking people, such as the *kh* sound of *ich* and *nicht*, pronounced like the *h* in *inhuman* when whispered.

Germans pronounce *v* with a sound like the English *f*, and *w* like the English *v*. The combination *ei* is always pronounced like the English *eye* and the combination *ie* always has the English *ee* sound, as in *need*.

Development. German speech varies considerably from place to place. But experts distinguish two main speech regions, *Low German* or *Plattdeutsch* ("flat German"), spoken in the flat northern plains; and *High German* or *Hochdeutsch*, spoken in the higher or mountainous regions of central and southern Germany. The printed language is based on High German. Almost all books and newspapers use this form, even in Low German regions. The differences in dialects are clearest in the everyday conversations of the people.

High German. Scholars recognize three stages of High German: Old High German, Middle High German, and New High German. Old High German was spoken in the central and southern German regions between about A.D. 750 and 1050. Middle High German was the written language used in the same regions between about 1050 and 1500. When Martin Luther translated the Bible into German in the 1500's, he based his translation on the dialect of east-central Germany, then called Saxony. This region then became important in the development of New High German.

Low German differs from High German chiefly in the sounds of its consonants. It sounds more like Dutch and English than High German does. For example, the Low German *eten* and *twe* are closer to the English *eat* and *two* than to the High German *essen* and *zwei*. Low German served as the spoken and literary language of northern Germany until the 1550's, when it lost its importance as a written language.

HELENA M. GAMER

See also GERMAN LITERATURE; LANGUAGE.

GERMAN LITERATURE

GERMAN LITERATURE is the literature of the German-speaking peoples of Central Europe. It includes works from Germany, Austria, Switzerland, and such neighboring regions as Alsace, Bohemia, East Prussia, and Silesia.

Almost all German literature is written in *High German*, the language of the mountain regions of southern and central Germany. Few important works have appeared in *Low German*, the language of northern Germany. German literature can be divided into three periods, based on changes in the language: Old High German, from A.D. 800 to 1050; Middle High German, from 1050 to 1500; and New High German, from 1500 to the present.

The history of German literature has been marked by high peaks and low periods. Its first flowering came in the Middle High German period, around 1200. It enjoyed a second golden age around 1800, during the lifetime of one of its greatest authors, Goethe.

Characteristics of German Literature

German literature is decentralized and often regional. This came about because for hundreds of years the German-speaking peoples had no capital or center of culture such as the French had in Paris.

German writers and poets developed as individuals. They had little concern for the conventions of polished society. They were equally uninterested in smoothness, elegance, or regularity of form for their own sake. Literary academies and rule-books, which served as supreme umpires in literary matters for the French and Italians, never succeeded in Germany.

German authors have constantly sought to evaluate man's relationships to God and nature. Their unquenchable thirst for knowledge is best exemplified in the legend of Faust, a magician who made a pact with the devil in order to gain his ends. The story of *Dr. Faust* was first published anonymously in Frankfurt in 1587. The Faust theme continued to appear in German plays, stories, and poems. Goethe used it for his drama *Faust*, one of his greatest works. In recent times, it was the basis for Thomas Mann's profound novel, *Dr. Faustus*. See FAUST.

In their individual ponderings about life, German authors are apt to become philosophical and involved. Answering weighty questions is far more important to them than mere beauty or elegance of expression. German poets have found lyric poetry the ideal expression for their personal, and at times musical, genius. German novelists often use a cumbersome and tortured style to express their involved and problematical thoughts. In the field of drama, German tragedies outnumber comedies by at least five to one.

Early German Literature

The early Germanic tribes that migrated to Western Europe composed ballads and stories about their gods and heroes. They passed these on by word of mouth from one generation to the next. About A.D. 800, at the end of the period of migrations, monasteries became the centers of learning and literature. The monks spread Christian teachings through poems and stories based on the Bible and on Christian legends. Otfried von Weis-

GERMAN LITERATURE

senburg (800?-880?), a monk who became the first German author known by name, impressed his readers with *The Book of Gospels* written in rhyme. *Heliand*, an anonymous epic in the Low German language, pictured Jesus as a Saxon chief and His disciples as warriors.

The monks also began to record some of the old heroic sagas and to compose new ones to glorify the feudal lords of their time. One of the few heroic poems to survive is the anonymous *Lay of Hildebrand*, the story of a battle between a father and son. Charlemagne and his successors encouraged Latin learning. About 930, Ekkehard (910?-973), a monk at the Swiss monastery of St. Gallen, put the Germanic tale of *Walther with the Strong Hand* into the form of a Latin epic. Notker (952?-1022), another monk at St. Gallen, translated Boethius and some of the works of Aristotle.

The First Golden Age (1050-1250)

German literature burst into sudden bloom during the crusades in the 1100's. Knights, rather than monks, became the culture bearers of the period. Knightly poets wrote *epics*, or narrative poems, on themes of love and chivalry (see *EPIC*). German minstrels called *minnesingers* wandered from court to court composing lyrical poems of love and adventure (see *MINNESINGER*). The elegance and grace of French court literature had a strong influence on German poetry.

Epic Poetry was a major contribution of Middle High German literature. Anonymous authors recorded such

old Germanic tales as the *Song of the Nibelungs* and *Gudrun* (see *NIBELUNGENLIED*). They added a thin coating of Christian chivalry to these popular epics. But basically the poems remained monuments to the period of old Germanic valor and loyalty.

Court epics showed the influence of French form. Many were based on tales of King Arthur that had come to Germany by way of France (see *ARTHUR, KING*). The crusades also offered a rich lore of fairylike adventures in distant lands. Hartmann von Aue, born about 1170, was the first major German poet to use Arthurian themes. But he gained his greatest fame with the epic, *Poor Henry*, the story of a stricken Swabian knight. In his *Parzival*, the greatest work of the Middle Ages in Germany, Wolfram von Eschenbach (1170?-1220?) combined a glittering tale of a knight-errant with an earnest description of a search for God. Gottfried von Strassburg, who lived in the early 1200's, imitated French grace in his version of *Tristan and Isolde*.

The Minnesingers became popular in the 1100's and 1200's. Many of their lyric poems imitated the songs of the French troubadours (see *TROUBADOUR*). The most famous minnesinger was Walther von der Vogelweide (1170?-1230?). He transformed the often insincere poems of the troubadours into warm and genuine expressions of love. Walther was the first great German poet to glorify nature.

The Interim Period (1250-1750)

Popular Literature. The period from 1250 to 1600 witnessed the decline of knighthood within the Holy

German Literature

Masters of German Literature from the 1700's to the present include some of the greatest literary figures of the world. The names in each category of the table are in chronological order. German literature enjoyed a golden age as early as the 1100's with the poetry of Wolfram von Eschenbach and Walther von der Vogelweide.

Hansel and Gretel (1812)
by the Grimm brothers



PROSE WRITERS

SCHOPENHAUER (1788-1860)

WILHELM GRIMM (1786-1859)

JACOB GRIMM (1785-1863)

HEINE (1797-1856)

HEBBEL (1813-1863)

GRILLPARZER (1791-1872)

POETS

NOVALIS (1772-1801)

SCHILLER (1759-1805)

GOETHE (1749-1832)

LESSING (1729-1781)

KANT (1724-1804)

WIELAND (1733-1813)

HERDER (1744-1803)

KLOPSTOCK (1724-1803)

DRAMATISTS

1725

1750

1775

1800

1825

1850

Roman Empire (see HOLY ROMAN EMPIRE). People of the middle class emerged as the next cultural leaders. The romantic idealism of the 1200's gave way to middle-class realism, sobriety, and satire. Epics such as *Meier Helmbrecht* by Wernher the Gardener described the degeneracy of the knighthood. Fables became popular as a means of teaching practical lessons. The mocking epic of *Reynard the Fox* and the merry pranks of *Till Eulenspiegel* won wide acclaim. Religious plays, such as the *Redentin Easter Play* and the *Oberammergau Passion Play*, originally combined religious fervor with realistic coarseness and laughter.

In the 1400's and 1500's, *meistersingers*, or master-singers, attempted to revive the lyric poetry of the minnesinger (see MASTERSINGER). The poems and plays of Hans Sachs (1494-1576), a shoemaker and uninspired mastersinger from Nuremberg, are typical examples of the homespun effort of the middle class to produce literature.

The Renaissance in Germany took the form of a spiritual rebirth during the 1500's. There was no major revival of arts and letters similar to that of the Italian Renaissance (see RENAISSANCE). But two outstanding features of the Renaissance achieved greatness in German-speaking regions. They were humanism and the Reformation (see HUMANISM; REFORMATION).

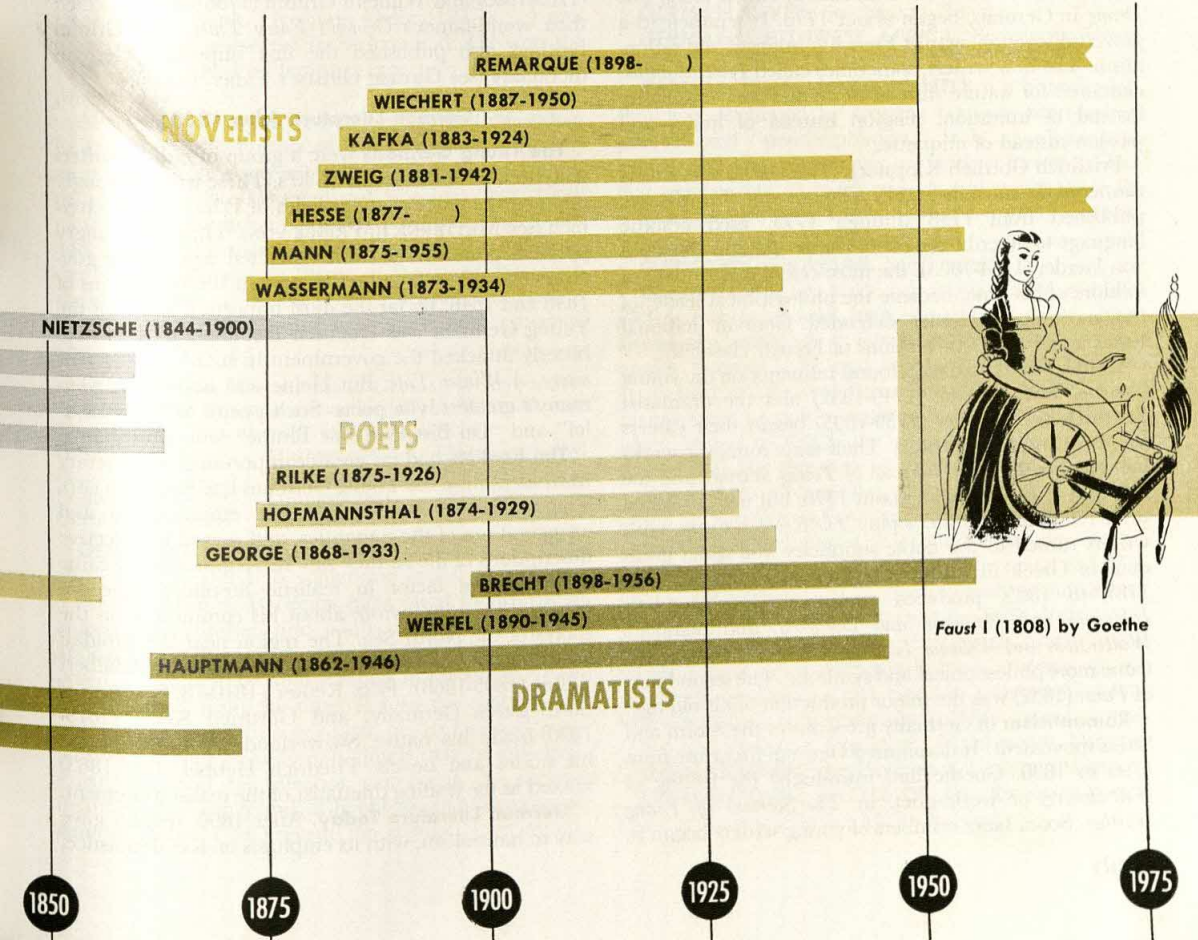
German humanism began in Bohemia around 1350 with the writings of Johannes von Saaz. It reached its height from 1480 to 1530. The humanists delved into the philosophy and history of ancient Greece and Rome in their search for a new ideal of man. They wrote most

of their works in Latin and Greek. Desiderius Erasmus (1466-1536) ranked as the foremost humanist of the northern Renaissance. Other outstanding humanists included Johannes Reuchlin (1455-1522), a leading scholar of Hebrew; Philipp Melancthon (1497-1560), a close friend of Martin Luther; and Ulrich von Hutten (1488-1523), an ardent nationalist and enemy of the Roman Catholic Church.

The Reformation, which began in 1517, left a lasting mark on German life and culture. Most of the literature it produced was in the form of religious essays and pamphlets. Martin Luther (1483-1546) translated the Bible into German, thus preparing the way for a standard German language. He wrote several important treatises to support his program of religious reform. Thomas Murner (1475-1537) was Luther's most bitter religious and literary opponent.

Baroque Literature. The religious wars that grew out of the Reformation produced a strongly pessimistic and despairing literature in the 1600's. Often called *baroque literature*, it was bombastic and highly emotional. Powerful and imploring church hymns thrived as never before. Andreas Gryphius (1616-1664), the greatest poet and dramatist of the age, wrote deeply moving religious poetry that preached steadfastness to God. In *Simplicius Simplicissimus*, Hans Jakob von Grimmelshausen (1620?-1676) told the story of a hero who found his way to God in spite of the horrors and crimes of the Thirty Years' War.

GERMAN LITERATURE



GERMAN LITERATURE

French classicism exerted a strong influence on German literature from about 1680 to 1750. Rigid classical rules stifled German creativity, and much of the writing seems a poor imitation of French literature.

The Second Golden Age (1750-1830)

All the arts in Germany flourished from the second half of the 1700's through the early 1800's. Men such as Goethe in literature, Immanuel Kant in philosophy, and Ludwig van Beethoven in music created the richest cultural period in German history. For the first time, German literature won fame and prestige throughout Europe and the Americas.

The Enlightenment came to Germany during the second half of the 1700's. German writers were caught up in the spirit of reform that swept across Europe. In literature, the enlightenment took the form of a resurgence of national pride and a rejection of French influence. Gotthold Ephraim Lessing (1729-1781), Germany's first important literary critic, laid the basis for a German national literature of true greatness. Lessing turned from French classical models to ancient Greek ones. His dramas tried to blend Greek restraint with Shakespearean greatness. One of his best-known plays, *Nathan the Wise*, preached religious tolerance.

The spirit of the enlightenment also appeared in the writings of Christoph Martin Wieland (1733-1813). Through his novels and verse epics, Wieland did more to enrich the German language than any previous poet.

The Storm and Stress Movement, called *Sturm und Drang* in German, began about 1770. It represented a powerful reaction against French formalism and rationalism. The new writers, sometimes called *Pre-Romantics*, clamored for nature instead of civilization, originality instead of imitation, religion instead of irony, and passion instead of etiquette.

Friedrich Gottlieb Klopstock (1724-1803) was a forerunner of the movement. His religious epic *The Messiah*, published from 1748 through 1773, used ecstatic language to describe the life of Christ. Johann Gottfried von Herder (1744-1803), the most celebrated student of folklore of his time, became the philosophical leader of the movement. Herder defended German national tastes against the conventions of French classicism.

Herder's work had a profound influence on the young Goethe. Both Goethe (1749-1832) and the dramatist Friedrich von Schiller (1759-1805) began their careers as Storm and Stress writers. Their early romantic works include Goethe's *The Sorrows of Young Werther* and the first part of *Faust* (begun about 1770, but not published until 1808), and Schiller's play *The Robbers*. Later, both writers turned to the noble simplicity and quiet grandeur of Greek literature. Their classical period, from 1787 to 1805, produced such works as Goethe's *Iphigenia* and *Hermann and Dorothea*, and Schiller's *Wallenstein* and *William Tell*. Goethe's later writing became more philosophical and symbolic. The second part of *Faust* (1832) was the major production of his old age.

Romanticism in Germany grew out of the Storm and Stress movement. It dominated German literature from 1790 to 1830. Goethe had introduced the feeling of *Weltschmerz*, or world-grief, in *The Sorrows of Young Werther*. Soon, large numbers of young writers began to

suffer from the utter pessimism and disillusionment of *Weltschmerz*. They expressed themselves through emotional and highly subjective writings. Many turned from their own society to the glories of their national past, particularly that of the Middle Ages. The color and fantasy of fables and fairy tales also attracted many young romantics.

The publication of Goethe's *Werther* brought international fame to German literature. Early translators of German works included the English romantics Sir Walter Scott and Thomas Carlyle. Although German romanticism had run its course by 1830, it continued to influence literature in the rest of the world for many years.

The list of romantic writers includes some of the greatest names in German literature. The brothers August Wilhelm von Schlegel (1767-1845) and Friedrich von Schlegel (1772-1829) led the movement and won international recognition for their literary criticism. Melancholy poets such as Novalis, whose real name was Friedrich von Hardenberg (1772-1801), and Nikolaus Lenau (1802-1850) expressed the pessimism and despair of the romantics. Heinrich von Kleist (1777-1811) and Franz Grillparzer (1791-1872) became known as the foremost dramatists of the romantic age. E. T. A. Hoffmann (1776-1822) wrote novels and stories based on fantasy and horror. Clemens Brentano (1778-1842) and Ludwig von Arnim (1781-1831) made important contributions to the field of folklore. Their book *The Boy's Magic Horn* was the first systematic collection of German folk songs. About the same time, Jacob Grimm (1785-1863) and Wilhelm Grimm (1786-1839) collected their world-famous *Grimm's Fairy Tales*. The Grimm brothers also published the first important German dictionary (see GRIMM; GRIMM'S FAIRY TALES).

German Literature After 1830

The Young Germans were a group of radical writers who became active in the 1830's. These writers strongly opposed the reactionary policies of Prince von Metternich (see METTERNICH, PRINCE VON). They wrote angry political dramas and stories directed against the government, and took an active part in the revolutions of 1830 and 1848. By far the most important leader of the Young Germans was Heinrich Heine (1797-1856). He bitterly attacked the government in such works as *Germany, A Winter Tale*. But Heine was also one of Germany's greatest lyric poets. Such poems as "The Lorelei" and "Du Bist Wie eine Blume" won world fame.

The Realists had far greater importance as a literary movement than the Young Germans had (see REALISM). The realists revolted against the emotionalism and exaggerations of the romantics, and turned to objective descriptions of life as they saw it. Regionalism became an important factor in realistic literature. Theodor Storm (1817-1888) wrote about his community on the shores of the North Sea. The region near the Moldau River served as the setting for the works of Adalbert Stifter (1805-1868). Fritz Reuter (1810-1874) wrote of northeastern Germany, and Gottfried Keller (1819-1890) made his native Switzerland the backdrop for his stories and novels. Friedrich Hebbel (1813-1863) ranked as the leading dramatist of the realist movement.

German Literature Today. After 1890, realism gave way to naturalism, with its emphasis on social injustice,

crime, and slum conditions. *The Weavers* by Gerhart Hauptmann (1862-1946) is the outstanding example of naturalistic drama.

Other literary "isms" replaced naturalism. Impressionism emphasized the aesthetic and idealistic in literature (see IMPRESSIONISM). It was represented by Thomas Mann (1875-1955) with *Buddenbrooks*, Jakob Wassermann (1873-1934) with *The World's Illusion*, and Ricarda Huch (1864-1947) with *Recollections of Ludolf Ursleu the Younger*.

Expressionism stressed the subjective, romantic, and visionary (see EXPRESSIONISM). It had a profound influence on the novels and stories of Franz Kafka (1883-1924) and Franz Werfel (1890-1945), and on the dramas of Ernst Toller (1893-1939) and Georg Kaiser (1878-1945). Bertolt Brecht (1898-1956) combined satire with expressionism in his musical drama *The Threepenny Opera*. Erich Maria Remarque (1898-) gained a reputation as a pacifist after the publication of his novel *All Quiet on the Western Front* in 1929.

Lyric poetry grew in the early 1900's with the works of Hugo von Hofmannsthal (1874-1929), Stefan George (1868-1933), and Rainer Maria Rilke (1875-1926).

Nazism, which swept Germany in the early 1930's, attempted to control literature for its own purposes. Many of the best authors left Germany in protest or were driven out. Thomas Mann went to the United States and later returned to Switzerland. Stefan George, whose ideal of an intellectual *élite*, or ruling class, was perverted by Nazi leaders, died in Switzerland. Stefan Zweig (1881-1942), a master of the psychological novel, committed suicide in Brazil, and Ernst Toller did the same in New York. Hermann Hesse (1877-) produced most of his works in Switzerland. He won the 1946 Nobel prize for literature, especially for his novel *Magister Ludi*.

After World War II, many German authors sat in judgment on the horrors of the recent past. For example, Carl Zuckmayer (1895-) analyzed militarism in *The Devil's General*, Ernst Wiechert (1887-1950) pictured concentration camps in *The Forest of the Dead*, and Theodor Plievier (1892-) made the defeat of the Nazis in Russia the theme of *Stalingrad*. But, with the exception of the Swiss author Friedrich Dürrenmatt (1921-), no outstanding new figures have appeared on the literary scene.

WERNER P. FRIEDERICH

Related Articles. See the list of German writers under Authors in the BIOGRAPHY section of the READING AND STUDY GUIDE. See also the following articles:

Drama	Mastersinger	Nibelungenlied
Faust	Mephistopheles	Novel
French Literature	Minnesinger	Realism
German Language	Nazism	Romanticism

GERMAN MEASLES is a highly contagious, but usually mild, disease. It is sometimes called *Rubella* and *Three-Day Measles*. It occurs most often in the spring among both children and adults. The first symptoms appear one to three weeks after the person has been exposed. There may be mild soreness in the throat, fever, and discharge from the nose. A rose-red, spotted rash usually appears about a day later, on the face and other parts of the body. The lymph glands may be enlarged. Pneumonia and ear infection can occur. No specific treatment has been found, although doctors use serum or gamma globulin to prevent the disease. One attack

GERMANTOWN, BATTLE OF

usually protects an individual for life against further attacks. If a woman gets German measles during the first three months of her pregnancy, it increases the chance that her baby will be born with a defect. See also MEASLES.

AUSTIN EDWARD SMITH

GERMAN SHEPHERD is often called the German police dog. It usually stands about 24 inches high, and weighs from 60 to 85 pounds. The German shepherd resembles a wolf in shape, walk, and color, and has erect ears and a long, slender muzzle. German shepherds vary in color from black and tan to white.

This dog was first bred in Germany as an outdoor guard. The German shepherd is intelligent, alert, loyal, and has a good disposition. It is sometimes called the "German police dog" because many of these dogs have been trained for police work. They became popular during World War I when the German Army used them to carry messages. Female German shepherds are often used as guide dogs for the blind. HENRY P. DAVIS

See also DOG (color picture, Working Dogs).

GERMAN SHORT-HAIRED POINTER is a sporting dog often used to hunt game birds. It works well as a pointer on land, and serves as a retriever on land and in the water. It works more slowly than some other hunting dogs, but it has an unusually keen sense of smell. The German short-haired pointer is a little larger than a regular pointer. It stands from 21 to 25 inches at the shoulder, and weighs from 45 to 70 pounds. Its short coat is liver-colored or liver and white. WILLIAM F. BROWN

See also DOG (color picture, Sporting Dogs).

GERMAN SILVER. See NICKEL SILVER.

GERMAN SOUTHWEST AFRICA. See SOUTH-WEST AFRICA.

GERMAN WIRE-HAIRED POINTER is a hunting dog that was developed by crossing German short-haired pointers and "poodle-pointers." It is an all-purpose hunter and a good retriever on land or in water. The dog weighs from 55 to 65 pounds and stands 24 to 26 inches high. Its color varies from brown to brown and white with liver-colored spots. JOSEPHINE Z. RINE

GERMANICUS CAESAR. See TIBERIUS.

GERMANIUM, *jur MAY nih um* (chemical symbol, Ge), is a shiny, brittle, hard, silver-white metal. As a chemical element, it is closely related to silicon. Its atomic number is 32, and its atomic weight is 72.60. Its density is 5.36, and its melting point, 958°C. Germanium can be partly oxidized to germanium dioxide when heated to 730°C. in oxygen. It does not react with acids, but dissolves in fused sodium hydroxide.

Germanium is comparatively rare, and is usually found in small quantities, mixed with other metallic ores. In the United States, it is found in the zinc ores of Missouri, Kansas, and Oklahoma. The metal today is used in the manufacture of rectifiers such as transistors. These germanium semiconductors use little electric current, do not generate heat, last much longer than vacuum tubes, and take up little space in electronic instruments or devices. The German chemist Clemens Winkler discovered germanium in 1886. GEORGE L. BUSH

See also ELEMENT, CHEMICAL; MENDELEEV, DMITRI.

GERMANTOWN. See PASTORIUS, FRANCIS DANIEL.

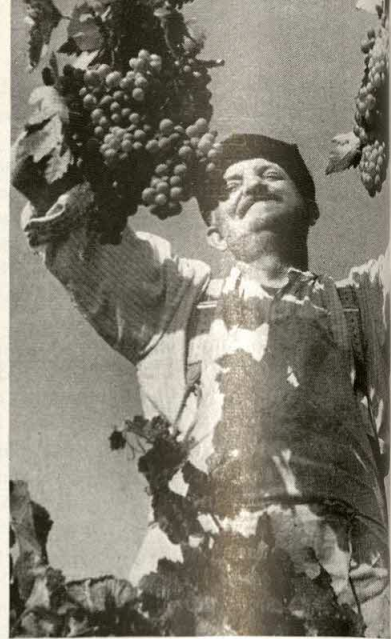
GERMANTOWN, BATTLE OF. See REVOLUTIONARY WAR IN AMERICA (table, Major Battles).



GERMANY

Colorful National Costumes often are worn to celebrate festivals in Germany. Castles and vineyards line the banks of the beautiful Rhine River.

German Tourist Information Office



GERMANY is a powerful nation in Central Europe. Since World War II, Germany has been divided into two countries. The larger of these countries is a democratic republic commonly called *West Germany*. The official name of this country in the German language

FACTS IN BRIEF

Type of Government: *West Germany*, federal republic; *East Germany*, republic (communist dictatorship).

Capital: *West Germany*, Bonn; *East Germany*, Pankow section of East Berlin.

Divisions: *West Germany*, 11 *Länder*, or states; *East Germany*, 14 districts.

Head of State: *West Germany*, President, chosen every five years by a special convention. *East Germany*, Chairman of the Council of State, elected every four years by the People's Chamber.

Parliament: *West Germany*, Federal Diet: *Bundestag* or lower house (497 members elected by the people for 4-year terms, and 22 non-voting members from West Berlin); *Bundesrat* or upper house (3 to 5 delegates appointed by each state government for indefinite terms).

Area: 137,441 square miles (*West Germany*, 95,904 square miles; *East Germany*, 41,537 square miles). **Greatest distance:** (north-south) 525 miles; (east-west) 390 miles. **Coast line**, about 680 miles.

Elevation: **Highest**, Zugspitze, 9,721 feet above sea level; **Lowest**, sea level.

Population: 71,349,500 (*West Germany*, 53,517,300; *East Germany*, 17,832,200). **Density**, 517 persons per sq. mi.

Chief Products: *Agriculture*, apples, barley, corn, flax, grapes, hay, hops, oats, pears, potatoes, rye, sugar beets, wheat. *Manufacturing*, aluminum, automobiles, beer, cameras, chemicals, chinaware, clocks, clothing, drugs, leather, machine tools, metalware, optical instruments, potash, ships, steel, textiles, toys, watches, wine, woodenware. *Mining*, amber, coal, lead, nickel, salt, silver, uranium, zinc.

Flag: The flag has three broad horizontal stripes, the top black, the center red, and the bottom gold. *East Germany's* flag has a design in the center. See **FLAG** (color picture, *Flags of Europe*).

National Anthem: *West Germany*: "Deutschland-Lied" ("German National Anthem"). *East Germany*: "National-Hymne der Deutschen Demokratischen Republik" ("National Anthem of the German Democratic Republic").

Money: *Basic unit*, Deutsche mark. For its value in dollars, see **MONEY** (table, *Values*). See also **MARK**.

is **BUNDESREPUBLIK DEUTSCHLAND**, or **FEDERAL REPUBLIC OF GERMANY**. The capital of *West Germany* is Bonn. The other part of Germany is a communist dictatorship controlled by Russia. It is commonly called *East Germany*. The official name of *East Germany* is **DEUTSCHE DEMOKRATISCHE REPUBLIK**, or **GERMAN DEMOCRATIC REPUBLIC**, although the communist government is actually neither democratic nor a true republic. The capital of *East Germany* is the Pankow section of East Berlin.

West Germany is over twice as large, and has nearly three times as many people, as *East Germany*. *West Germany* is rich in natural resources and is an important industrial country. *East Germany* has fewer natural resources and is an agricultural country.

The history of Germany is a story of wars. German governments have been blamed for starting both World War I and World War II. In both wars, most of the other countries of the world united to defeat Germany.

On the other hand, German artists, scientists, and scholars have contributed greatly to the world as we know it today. Books were first printed in Germany. Germans were the first to teach great masses of their people to read and write. In the 1500's, Germany was the center of the religious struggle called the Reformation. Germans have written some of the world's finest music and most-discussed philosophy. German scientists have made many important discoveries in such fields as physics, medicine, and chemistry.

The Land and Its Resources

Location, Size, and Surface Features. Germany takes up the heart of the continent of Europe. The *Color Map* shows it has land on all sides except the north, where it faces the North and Baltic seas. *West Germany* is almost the size of Michigan and Ohio together. *East Germany* is slightly larger than Ohio. Germany covers 137,441 square miles.

Germany as a whole divides into two sharply different regions, a northern lowland and a central and southern highland. The lowland is part of the great plain of northern Asia and Europe, and covers all

northern Germany. It is generally level, although in some places it rises into hills a thousand feet or more above sea level. The plain slopes down to the north and northwest, and levels out into low-lying coastal flats along the northern shores.

The coast line is regular, with few good harbors. Some of the rivers which empty into the North Sea have cut channels wide and deep enough to make usable ports.

The highlands of central Germany lie south of the great northern plain. Here the surface of the land is uneven. High, flat plains are edged by rolling hills and scattered mountain ranges, and rivers cut deep valleys through the land. The mountaintops in central Germany are low and rounded. The Erzgebirge, or Ore Mountains, of this region get their name from the deposits of iron, silver, copper, and other ores in them.

The Harz Mountains lie at the northern edge of the central highlands. The highest point in the Harz Mountains is the Brocken, which rises more than 3,700 feet and stands cloaked in gloom and mist. The Schwarzwald, or Black Forest, is a mountain range in southwestern Germany. It takes its name from the heavy

along the German coast include the Ems, the Weser and the Elbe. The chief German port of Hamburg is near the mouth of the Elbe, and the important port of Bremen lies near the mouth of the Weser. Certain branches of the large German rivers are important streams in their own right. Such branches include the Main and Moselle rivers, which empty into the Rhine, and the Saale River, which flows into the Elbe. The Oder River drains into the Baltic Sea.

The loveliest lakes in Germany are in the southern hills and mountains. Here the glaciers of early times carved deep basins in the rocks. These basins are now mountain lakes, filled with clear, cold water. Their edges are great cliffs and rocky slopes. Waterfalls leap noisily down the sides of the mountains. The white waters churn along through narrow channels until they smooth out and are lost in the quiet depths of the blue lakes. The scenery around the Königssee (Royal Lake), in Bavaria, is especially wild and beautiful.

Many shallow lakes are scattered about the great plain of northern Germany. Many partly landlocked bays called *haffe* edge the Baltic Coast and receive the rivers which empty into the Baltic. The haffe are shallow and ringed with sand dunes. The chief German bays are along the North Sea coast.

Natural Resources. Only about one fourth the land of Germany is well suited to agriculture, and more than half this farm land is in East Germany. In the north the soil is marshy or sandy, and must be heavily fertilized. In the narrow valleys of the Rhine and its branches, the land is fertile and good for raising crops.

Germany has great mineral wealth. The biggest coal fields in Europe are in the Ruhr region of West Germany around Essen. West Germany has some deposits of low-grade iron ore, and has the chief petroleum deposits in Europe. These lie along the border of The Netherlands. Fairly large deposits of zinc, lead, manganese, and copper also are found in West Germany. Both West and East Germany have large deposits of rock salt, potash, lignite, and kaolin. Deposits of amber are found along the Baltic Coast of East Germany.

The rivers of Germany provide water power to generate millions of kilowatt hours of hydroelectric power each year.

Germany has had many forests since early times,



Area of Germany Compared with Ohio and Michigan

forests of dark fir trees that cover the mountainsides. The highest point in the Schwarzwald is Feldberg, a peak 4,900 feet above sea level. Many German traditions and folk tales center around the Black Forest.

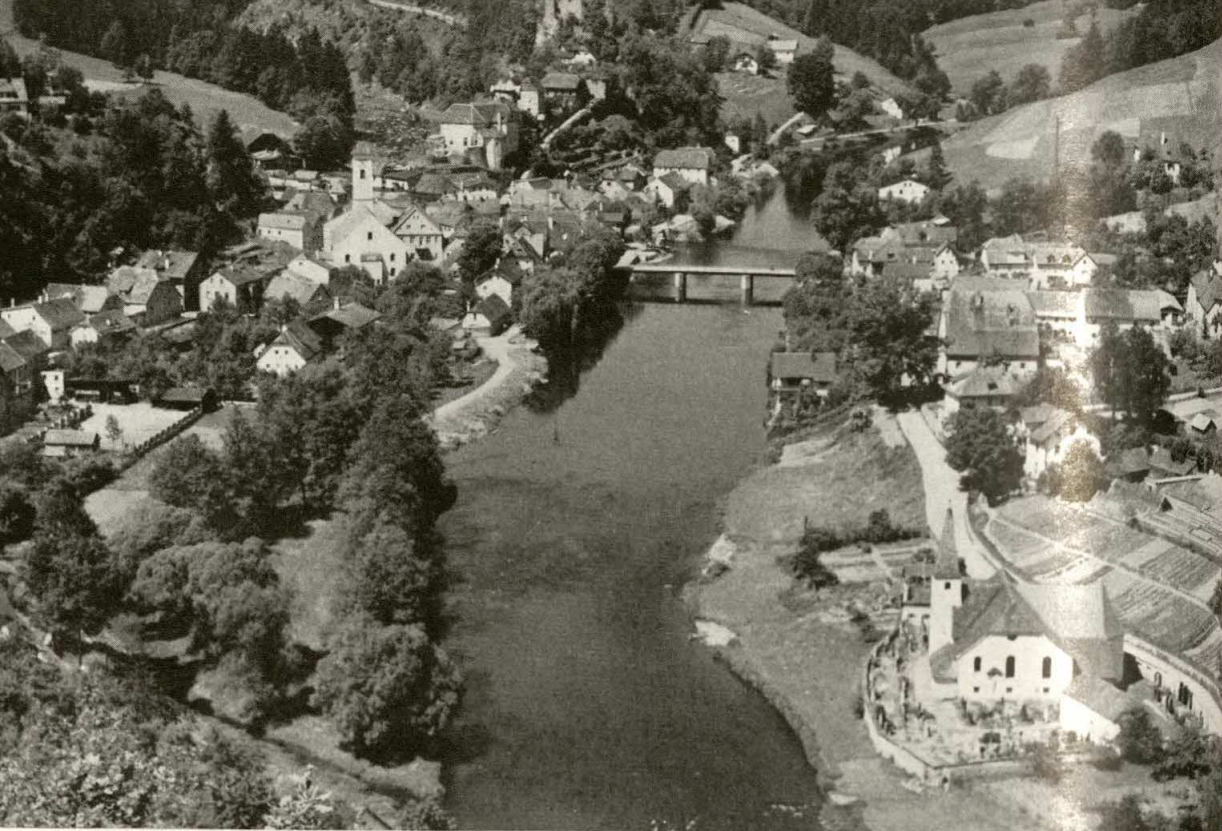
The Alps branch out from Switzerland into southeastern Germany. The highest point in Germany is the Alpine peak, Zugspitze, which rises 9,721 feet above sea level in southern Bavaria.

Rivers, Lakes, and Bays. Germany has many rivers. Most of them are open for inland waterway travel. The central highlands act as a great divide, and separate the rivers that flow north into the North and Baltic seas from those that flow south and east to find their way into the Black Sea. The most important of the rivers that flow east is the Danube. This river rises in the Black Forest and drains most of Bavaria.

The chief river in Germany is the Rhine, which empties into the North Sea through The Netherlands. Other important rivers that flow into the North Sea

Location Map of West and East Germany (in Black)





German Tourist Information Office

This German Village Lies on the Ilz River, Which Flows Through a Forest near the Border of Czechoslovakia.

when the land was almost covered with trees. Many old German folk tales and superstitions are connected with the forests. The story of Siegfried, for example, tells that he could be wounded only on his back, where he had been touched by a falling leaf. As Germany developed, the people took care to preserve the forest lands. Almost a quarter of the land surface in Germany is covered with trees, including pines, firs, oaks, beeches, and birches.

Climate. Germany lies about as far north as the area between the Great Lakes and the southern part of Hudson Bay in North America. But the climate in most of Germany is mild. Average temperatures are 40°F. in January and 70°F. in July. About 20 to 40 inches of rain falls annually in most of Germany.

The People and Their Work

The People. West Germany has a population greater than any other country in Europe except Russia. Almost five times as many people live in West and East Germany as in California, which has more area than these two countries together.

The Germans, or *Deutsche*, are Teutons, which means that they speak one of the Teutonic languages. This group of languages includes German, English, Dutch, Flemish, and the Scandinavian tongues of Norway, Denmark, Iceland, and Sweden. The Germans, like the inhabitants of all other European nations, have a mixed background of many races and ancestors. Many of the people in northern Germany are of the Nordic, or northern, type. These people are usually tall, with blue eyes, fair hair and skin, and oval heads. In southern Germany the Alpine, or mountain, type is frequently found. These people are likely to be short and plump,

with brown hair, dark eyes, and round heads. The two types are greatly mixed throughout Germany.

The Germans are famous for being thorough in everything they do. Their thoroughness has been applied to many fields, including literature, philosophy, science, music, manufacturing, and military conquest.

Few people in Europe have had so little opportunity for self-government, freedom, and democracy as the people of Germany. German obedience to authority has perhaps developed from years of control by first one form of strict government and then another. For hundreds of years, the German people were not allowed personal liberty or national union. They were divided into a number of small independent states.

Old customs and costumes have been preserved in parts of Germany that are cut off from the rest of the land by mountains and forests. Here, some of the women wear long, full-gathered skirts or jumpers, embroidered or banded in braid. Their blouses are snowy white, with great puffed sleeves pulled in close at the wrist or above the elbow. Sometimes a short jacket or bodice laces tight at the waist, and the whole outfit is topped with an apron of ruffled white or some gay color. Little girls wear their hair in braids, and their dresses are almost completely covered by cotton aprons that have sleeves, and tie in the back. Little boys wear short, straight pants held up by broad embroidered bands. In other parts of Germany the people dress much as Americans do.

The Germans generally are thrifty and hard-working people, noted for their cooking of special dishes and their love of cleanliness. Girls are trained to cook from the time they are very young. Old family recipes are

**Historic Divisions	
†ANHALT*	C 5
BADEN	D 3
BAVARIA (BAYERN)	**D 4
†BRANDENBURG (Prus.)	B 5
BRUNSWICK (BRAUNSCHWEIG)*	B 4
FRANCONIA (FRANKEN) (Bav.)*	D 4
HANOVER (HANNOVER) (Prus.)	B 2
HESSIE (HESSEN)	C 3
HESSIE-NASSAU (HESSEN-NASSAU) (Prus.)*	C 3
HOHENZOLLERN	D 3
LIPPE*	C 3
†MECKLENBURG	B 4
OLDENBURG*	B 3
PALATINATE, RHENISH (RHEINFALZ) (Bav.)*	D 3
PALATINATE, UPPER (OBERPFALZ) (Bav.)*	D 6
†POMERANIA (POM-MERN) (Prus.)*	B 6
†PRUSSIA (PREUSSEN)*	**
RHINELAND (RHEIN- LAND) (Prus.)	C 2
SAAR (SAARLAND)	D 2
†SAXONY (SACHSEN)	C 5
†SAXONY, PRUSSIAN (PREUSSISCH SACH- SEN) (Prus.)*	B 4
SCHLESWIG-HOLSTEIN (Prus.)	A 3
†SILESIA (SCHLESSEN) (Prus.)*	C 6
SWABIA (SCHWABEN) (Bav.)*	D 4
†THURINGIA (THURINGEN)	C 4
WESTPHALIA (WEST- FALEN) (Prus.)	C 2
WÜRTTEMBERG	D 3
WEST GERMANY	
Population... 53,517,300	
States	
BADEN- WÜRTTEMBERG*	D 3 Pop. 7,156,700
BAYERN (BAVARIA)*	D 4 Pop. 9,176,600
BERLIN, WEST*	B 5 Pop. 2,203,300
BREMEN*	B 3 Pop. 639,600
HAMBURG*	E 3 Pop. 1,781,500

HESSIE (HESSIE)*	C 3 Pop. 4,577,200
NIEDERSACHSEN (LOWER SAXONY)*	B 3 Pop. 6,548,100
NORDRHEIN-WESTFALEN (NORTH RHINE- WESTPHALIA)*	C 2 Pop. 14,856,100
RHINELAND-PFALZ (RHEINLAND-PALA- TINATE)*	D 2 Pop. 3,304,900
SAARLAND (SAAR)*	D 2 Pop. 996,200
SCHLESWIG- HOLSTEIN*	A 3 Pop. 2,277,300

Cities of West Germany

Aachen	151,100	C 2
Aalen	28,700	D 4
Ahlen	36,000	C 2
Ahrweiler	8,300	C 2
Aix-la-Chapelle, see Aachen		
Alsfeld	9,000	C 3
Amberg	43,100	D 4
Andernach	18,000	C 2
Ansbach	33,600	D 4
Arendsee		B 4
Arnsberg	20,500	C 3
Aschaffenburg	53,100	D 3
Augsburg	202,700	D 4
Aurich	9,600	B 2
Bad Godesberg*	58,800	C 2
Bad Hersfeld, see Hersfeld		
Bad Homburg [vor der Höhe]	33,900	C 3
Bad Kissingen	13,300	C 4
Bad Kreuznach	35,400	D 4
Bad Mergentheim	10,870	D 3
Bad Oldesloe	15,000	B 4
Bad Reichenhall	13,700	E 5
Bad Segeberg	11,635	B 4
Bad Tölz	12,800	E 4
Baden-Baden	40,800	D 3
Balje	1,900	B 3
Bamberg	76,400	D 4
Bassum		B 3
Bayreuth	60,600	D 4
Bensheim	23,400	D 3
Berchtesgaden	5,100	E 5
Bergedorf (part of Hamburg)		B 4
Bergisch Gladbach	35,800	C 2
Berlin (†East and West)	3,343,200	
(*3,900,000)		B 5
Biberach [an der Riss]	17,900	D 3
Bielefeld	172,700	B 3
Bingen	18,700	D 2
Bocholt	39,742	C 2
Bochum	342,400	C 2
Bonn	140,800	
(*255,000)		C 2
Boppard	8,700	C 2
Borghorst	15,074	B 2
Botropf	105,700	C 2
Brakel	6,137	C 2
Braunschweig	244,500	B 4
Bremen	508,600	B 3
Bremerhaven	131,000	B 3
Brilon	10,340	C 3
Bruchsal	18,900	D 3
Brückenaue		C 3
Brunswick, see Braunschweig		
Buchloe	5,400	D 4
Büren	6,058	C 3
Buxtehude	14,100	B 3
Cassel, see Kassel		
Castrop-Rauxel*	83,600	C 2
Celle	59,900	B 4
Clausthal-Zellerfeld	15,800	C 4

Cleve, see Kleve		
Cloppenburg		B 3
Coblence, see Koblenz		
Coburg	45,800	C 4
Coesfeld	17,900	C 2
Cologne, see Köln		
Constance, see Konstanz		
Craillheim	12,700	D 4
Cuxhaven	44,400	B 3
Dachau	25,700	D 4
Dannenberg	3,327	B 4
Darmstadt	124,400	D 3
Deggendorf	16,600	D 5
Delmenhorst	55,500	B 3
Detmold	32,300	C 3
Diepholz	9,100	B 3
Dillenburg	10,155	C 3
Dillingen [an der Donau]	9,900	D 4
Donauwörth	9,625	D 4
Dortmund	618,300	
(*835,000)		C 2
Duisburg	479,000	C 2
Düren	43,400	C 2
Düsseldorf	645,400	
(*900,000)		C 2
Ebingen	20,300	D 3
Eckernförde	20,200	A 3
Eichstätt	11,300	D 4
Einbeck	17,400	C 3
Ellwangen	10,700	D 4
Elmshorn	34,400	B 3
Emden	42,800	B 2
Emmerich	14,300	C 2
Emsdorf	23,700	B 2
Erding	8,800	D 4
Erlangen	62,100	D 4
Eschwege	23,800	C 4
Eschweiler	38,500	C 2
Essen	690,900	
(*3,700,000)		C 2
Esslingen [am Neckar]	77,500	D 3
Euskirchen	18,900	C 2
Flensburg	94,300	A 3
Forchheim	19,300	D 4
Frankenberger (Eder)	7,500	C 3
Frankenthal	28,700	D 3
Frankfurt [am Main]	640,000	
(*975,000)		C 3
Freiburg [im Breisgau]	129,000	E 2
Freising	26,000	D 4
Freudenstadt	13,200	D 3
Friedberg	17,100	C 3
Friedrichshafen	31,700	E 3
Fritzlar	6,900	C 3
Fulda	45,900	C 3
Fürth	101,000	D 4
Fürth im Wald	9,453	D 5
Füssen	10,200	E 4
Garmisch-Partenkirchen	25,800	E 4
Geislingen [an der Steige]	24,200	D 3
Gelsenkirchen	371,700	C 2
Gemünden	3,700	C 3
Gernsheim	6,481	D 3
Giessen	58,800	C 3
Gifhorn	11,950	B 4
Gladbeck*	79,200	C 2
Gmünd, see Schwäbisch Gmünd		
Goch	14,000	C 2
Göppingen	45,500	D 3
Goslar	40,200	C 4
Göttingen	80,200	C 3
Gronau [in Westfalen]	24,900	B 2
Gummersbach	31,500	C 2
Günzburg	8,933	D 4
Gütersloh	48,500	C 3
Hagen [in Westfalen]	179,200	C 2
Hall, see Schwäbisch Hall		
Hamburg	1,781,500	B 4
Hamel	50,300	B 3
Hamm [in Westfalen]	66,900	
(*125,000)		C 2
Hanau [am Main]	43,500	C 3
Hannover	532,200	B 3
Hannoversch Münden, see Münden		
Haselünne	4,800	B 2
Hassfurt	6,350	C 4
Hechingen	10,200	D 3

Heide	20,600	A 3
Heidelberg	128,300	D 3
Heidenheim	46,600	D 4
Heilbronn	79,100	D 3
Helmsdorf	29,900	B 4
Herford	54,000	B 3
Herne*	116,100	C 2
Hersbruck	8,945	D 4
Hersfeld	23,400	C 3
Herten*	49,500	C 2
Hildesheim	85,800	B 3
Höchst (part of Frankfurt)		C 3
Hof	57,800	C 4
Holzminde	23,600	C 3
Hörmum	1,900	A 3
Hoya	4,400	B 3
Husum	22,700	A 3
Ilbenbüren	14,619	B 2
Idar-Oberstein	26,984	D 2
Immenstadt [in Allgäu]	9,700	E 4
Ingolstadt	46,800	D 4
Isarhahn	50,900	C 2
Itzehoe	34,500	B 3
Jever	9,800	B 2
Kaiserslautern	90,400	D 4
Karlsruhe	222,600	D 3
Kassel	192,500	C 3
Kaufbeuren	28,900	E 4
Kelheim	11,951	D 4
Kempten [in Allgäu]	41,400	E 4
Kiel	257,300	A 4
Kirn	9,700	D 2
Kitzingen	17,600	D 4
Kleve	19,500	C 2
Koblenz	87,000	C 2
Köln (Cologne)	715,900	
(*1,275,000)		C 2
Konstanz	49,800	E 3
Krefeld	198,100	C 2
Kulmbach	23,700	C 4
Künzelsau	6,664	D 3
Lahr [in Schwarzwald]	22,900	D 2
Landau [an der Isar]	5,900	D 5
Landau [in der Pfalz]	26,500	D 3
Landsberg	12,000	D 4
Landshtut	48,000	D 5
Laupheim	8,200	D 3
Lauterbach	9,436	C 3
Leer	21,600	B 2
Legau	2,700	E 4
Lehrte	20,300	B 3
Lemgo	21,200	B 3
Leverkusen*	78,500	C 2
Lichtenfels	10,526	C 2
Limburg [an der Lahn]	15,900	C 3
Lindau [am Bodensee]	22,400	E 3
Lingen	22,400	B 2
Lippstadt	34,800	C 2
Lohr	11,114	C 3
Lörrach	28,100	E 2
Lübben	9,433	C 5
Lübeck	228,800	B 4
Ludwigscheid	55,700	C 2
Ludwigshafen [am Rhein]	150,200	D 3
Lüneburg	57,400	B 4
Lünen*	68,400	C 2
Mainz	117,000	D 3
Mannheim	290,700	
(*550,000)		D 3
Marburg [an der Lahn]	43,500	C 3
Marktgreditz	15,900	C 2
Marl*	64,800	C 2
Mayen	16,000	C 2
Memmingen	28,600	E 4
Meppen	13,100	B 2
Minden	47,500	B 3
Mitterteich	6,700	D 5
München-Gladbach	144,800	
(*250,000)		C 2
Mühlhof	10,700	D 5
Mühlheim [an der Ruhr]	168,300	C 2
Mühlheim	6,400	E 2
München (Munich)	968,200	
(*1,100,000)		D 4

(Map Index) GERMANY

München-Gladbach, see Mönchen-Gladbach		
Münden	19,200	C 3
Munich, see München		
Münster	7,700	B 4
Münster [in Westfalen]	155,700	C 2
Neu-Ulm	21,300	D 4
Neuburg [an der Donau]	12,900	D 4
Neumarkt [in der Oberpfalz]	14,300	D 4
Neumarkt-Sankt Viet	3,514	D 5
Neumünster	72,400	A 3
Neuss*	79,200	C 2
Neustadt [an der Aisch]	9,000	D 4
Neustadt [an der Wein- strasse]	31,300	D 3
Neustadt [bei Coburg]	13,200	C 4
Neustadt [im Schwarz- wald]	6,900	E 3
Neustadt [in Holstein]	15,200	A 4
Neuwied	27,100	C 2
Nienburg [an der Weser]	21,800	B 3
Norden	17,000	B 2
Nordenham	26,500	B 3
Nordhorn	38,400	B 2
Nördlingen	14,200	D 4
Northem	19,400	C 3
Nürnberg (Nuremberg)	419,000	
(*560,000)		D 4
Oberammergau*	4,800	E 4
Oberhausen	239,100	C 2
Oberstdorf	8,200	E 4
Offenbach [am Main]	104,400	C 3
Offenburg	27,300	D 2
Oldenburg [in Holstein]	8,200	A 4
Oldenburg [in Oldenburg]	120,800	B 3
Osnaabrück	126,600	B 3
Paderborn	47,200	C 3
Papenburg	15,300	B 4
Parsberg	2,500	D 2
Passau	33,500	D 5
Pegnitz	7,392	D 4
Peine	28,600	B 4
Penzberg	10,100	E 4
Pfaffenhofen	7,715	D 4
Pfarrkirchen	70,600	D 5
Pforzheim	70,800	D 3
Pirmasens	51,400	D 2
Plattling	8,361	D 2
Prüm	4,000	C 2
Quakenbrück	8,400	B 2
Rastatt	22,700	D 3
Ravensburg	29,200	E 3
Recklinghausen	123,500	C 2
Regensburg	124,100	D 5
Remagen*	6,800	C 2
Remscheid	117,300	C 2
Rendsburg	34,800	A 3
Reutlingen	61,400	D 3
Rheine	43,000	B 2
Rheinhausen	62,300	C 2
Rheydt*	88,700	C 2
Rosenheim	31,900	E 5
Rotenburg	13,500	B 3
Rothenburg [ob der Tauber]	11,400	D 4
Rottweil	17,400	D 2
Rüdesheim	6,666	D 3
Saarbrücken	121,600	
(*230,000)		D 2
Saarlouis	33,500	D 2
Saizgitter	99,500	B 4
Schleswig	53,600	A 3
Schlichtern	5,800	C 3
Schongau	7,700	E 4
Schramberg	17,700	D 3
Schrobenhausen	8,200	D 4
Schwabach	20,600	D 4
Schwäbisch Gmünd	35,900	D 3
Schwäbisch Hall	19,900	D 3
Schwandorf [in Bayern]	14,500	D 5
Schweinfurt	53,700	C 4

Source: Latest available official figures. † Places marked by a dagger are in East Germany. Places not marked are in West Germany.
 * Population of metropolitan area, including suburbs. * Place names marked by an asterisk do not appear on the map. Key shows general location.
 ** The historic divisions marked (Prus.), located in both East Germany and West Germany, were parts of the historic region of Prussia (Preussen). The historic divisions marked (Bav.) were parts of Bavaria.



GERMANY



Below Sea Level
No Vegetation Shown

- National Capitals (star in a circle)
- Cities (black dot)
- Railroads (black line with cross-ticks)
- Canals (blue line)

1 Inch = 47 Statute Miles

Miles 0 5 10 20 30 40 50

Lambert Conformal Conic Projection

Longitude East of Greenwich

NORTH

North Sea

HELGOLAND (GER.)

FRISIAN ISLANDS

EAST LANGEDEE

JUSTIN

BORKUM

Norden

Wilhelmshaven

Aurich

Emden

Greningen

Leerdam

Amsterdam

Rotterdam

Breda

Utrecht

Amersfoort

Arnhem

Nijmegen

Os

Wageningen

Enschede

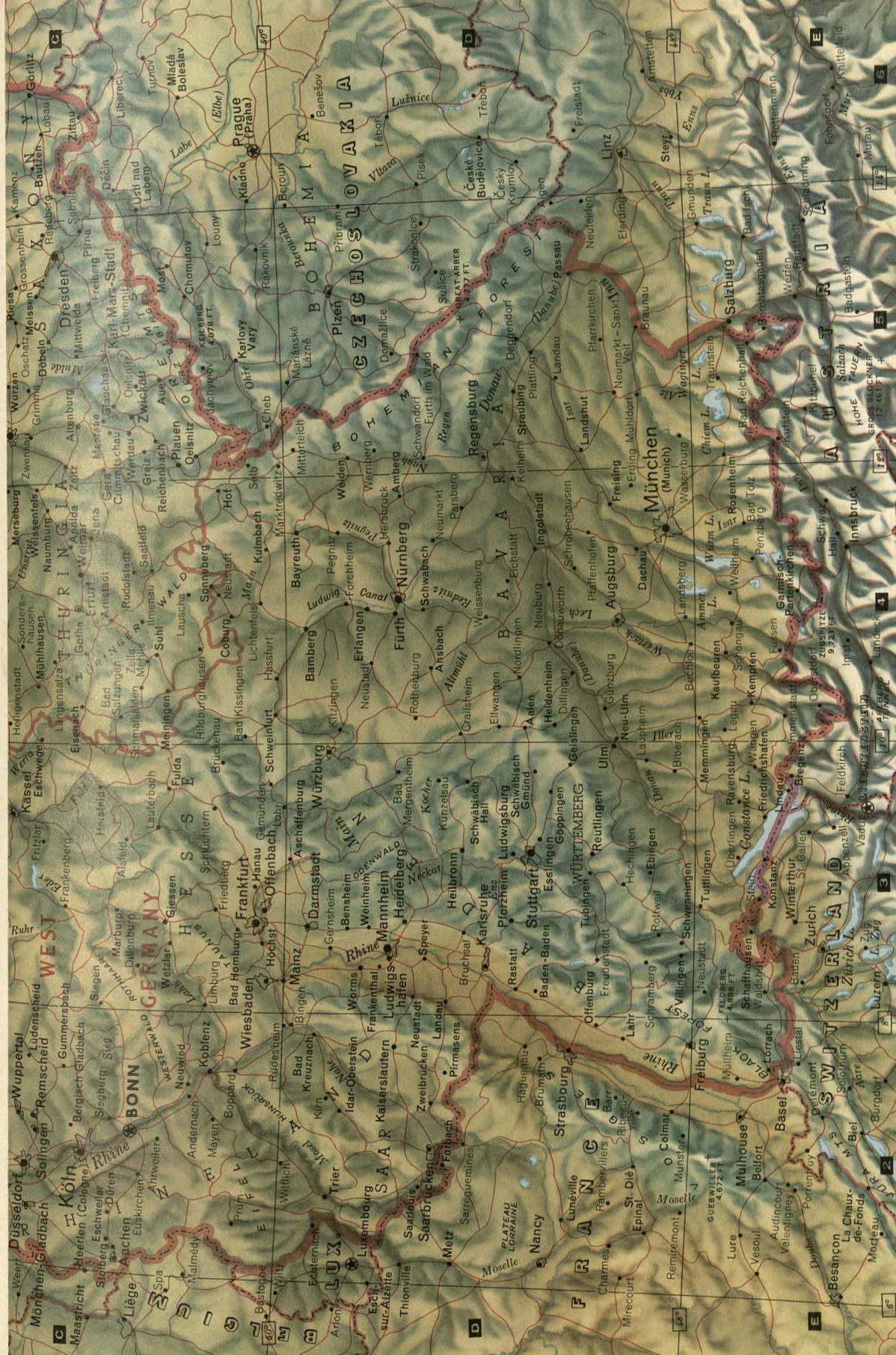
Zutphen

Doetinchem

Elst

Wierden

Beuningen



GERMANY (Map Index)

Schwenningen [am Neckar], 29,900	D 3
Selb, 19,100	C 5
Siegburg, 28,900	C 2
Siegen, 46,000	C 3
Soest, 31,900	C 3
Solingen, 162,800	C 2
Soltau, 14,200	B 3
Speyer, 35,600	D 3
Stade, 29,100	B 3
Stein	E 3
Stolberg, 35,600	C 2
Straubing, 36,600	D 5
Stuttgart, 602,900	
([*] 825,000)	D 3
Traunstein, 14,700	E 5
Trier, 86,700	D 2
Tübingen, 46,200	D 3
Tutlingen, 23,900	E 3
Überlingen, 9,500	E 3
Uelzen, 24,200	B 4
Ulm, 89,800	D 3
Varel, 12,600	B 3
Verden, 19,900	B 3
Villingen [im Schwarzwald], 26,800	D 3
Waldsloh, 10,600	E 3
Walsrode, 13,260	B 3
Wangen	E 3
Wanne-Eickel, [*] 101,100	C 2
Warburg, 10,071	C 3
Wasserburg [am Inn], 6,500	D 5
Weitenschied, [*] 75,500	C 2
Wendens, 40,500	D 5
Weilheim, 11,500	E 4
Weinheim, 26,700	D 3
Weissenburg [in Bayern], 13,900	D 4
Wernberg, 1,070	D 5
Wesel, 25,800	C 2
West Berlin, 2,203,300	B 5
Westerland, 9,100	A 3
Wetzlar, 32,400	C 3
Wiesbaden, 250,200	C 3
Wilhelmshaven, 98,500	B 3
Witten, [*] 91,000	C 2
Wittingen, 5,100	B 4
Wittlich, 8,900	D 2
Wolfenbüttel, 33,900	B 4
Wolfsburg, 44,800	B 4
Worms, 59,300	D 3
Wuppertal, 405,400	C 2
Würzburg, 101,700	D 3
Zeven, 6,593	B 3
Zweibrücken, 31,800	D 2

EAST GERMANY

Population... 17,832,200

Cities of East Germany

Altenburg, 48,300	C 5
Angermünde, 12,000	B 5
Anklam, 20,200	B 5
Apolda, 31,100	C 4
Arnstadt, 27,400	C 4
Artern, 7,601	C 4
Aschersleben, 36,400	C 4

Aue, 32,800	C 5
Bad Doberan, 12,200	A 4
Bad Freienwalde [an der Oder], 12,600	B 6
Bad Salzuflen, 10,000	C 4
Barby, 7,788	C 4
Barth, 13,000	A 5
Bautzen, 42,000	C 6
Beeskow, 7,571	B 5
Belzig, 7,597	B 5
Bergen [auf Rügen], 10,100	A 5
Bernau [bei Berlin], 13,900	B 5
Bernburg, 46,700	C 4
Bitterfeld, 32,500	C 5
Blankenburg [im Harz], 19,700	C 4
Brandenburg [an der Havel], 87,100	B 5
Burg, 30,000	B 4
Bützow, 11,100	B 4
Chemnitz, see Karl-Marx-Stadt	
Cottbus, 64,500	C 6
Crimmitschau, 33,400	C 5
Dahme, 6,391	C 5
Delitzsch, 23,700	C 5
Demmin, 17,100	B 5
Dessau, 94,300	C 5
Döbeln, 30,300	C 5
Dömitz, 4,585	B 4
Drebkau, 2,518	C 6
Dresden, 496,500	
([*] 680,000)	C 5
East Berlin, 1,139,900	B 5
Eberswalde, 32,300	B 5
Eilenburg, 18,800	C 5
Eisenach, 50,000	C 4
Eisleben, 30,100	C 4
Elsterwerda, 9,749	C 5
Erfurt, 188,100	C 4
Falkenberg, 7,831	C 5
Finsterwalde, 20,600	C 5
Forst, 29,700	C 6
Frankfurt [an der Oder], 57,200	B 6
Freiberg [in Sachsen], 45,800	C 5
Freienwalde, see Bad Freienwalde	
Friedland, 8,357	B 5
Fürstenberg [an der Oder], 5,259	B 6
Fürstenwalde [an der Spree], 32,700	B 6
Gardelegen, 12,800	B 4
Genthin, 18,400	B 5
Gera, 98,000	C 5
Glauchau, 34,900	C 5
Görlitz, 96,100	C 6
Gotha, 57,800	C 4
Greifswald, 45,800	A 5
Greiz, 40,800	C 5
Grimma, 16,000	C 5
Grossenhain [im Bezirk Dresden], 18,700	C 5
Guben, 24,000	C 6
Güstrow, 37,100	B 5
Hagenow, 11,000	B 4
Halberstadt, 45,500	C 4
Haldensleben, see Neuhaldensleben	

Halle [an der Saale], 289,700	C 4
Heiligenstadt, 12,700	C 4
Hildburghausen, 7,870	C 4
Hoyerswerda, 7,274	C 6
Ilmenau, 17,100	C 4
Jena, 83,100	C 4
Jüterbog, 14,500	C 5
Kamenz, 15,000	C 6
Karl-Marx-Stadt (Chemnitz), 290,200	C 5
Köthen, 39,100	C 4
Kyritz, 8,679	B 5
Langensalza, 16,800	C 4
Lauscha, 6,506	C 4
Leipzig, 613,700	
([*] 825,000)	C 5
Löbau, 17,700	C 6
Lübben, 9,433	C 5
Luckau, 6,145	C 6
Luckenwalde, 29,600	B 5
Ludwigslust, 12,500	B 4
Magdeburg, 261,400	B 4
Malchin, 6,825	B 5
Malchow, 8,049	B 5
Meerane, 25,900	C 5
Meiningen, 23,600	C 4
Meissen, 49,900	C 5
Merseburg, 41,600	C 4
Mittweida, 20,800	C 5
Mühlhausen [in Thüringen], 47,100	C 4
Nauen, 13,100	B 5
Naumburg [an der Saale], 39,300	C 4
Neubrandenburg, 27,000	B 5
Neuhaldensleben, 22,000	B 4
Neuruppin, 23,500	B 5
Neustadt [an der Dosse], 2,152	B 5
Neustrelitz, 27,900	B 5
Nordhausen, 39,200	C 4
Oelsnitz [im Erzgebirge], 17,100	C 5
Oelsnitz [im Vogtland], 20,100	C 5
Oranienburg, 20,800	B 5
Oschatz, 15,800	C 5
Oschersleben, 19,700	B 4
Parchim, 19,600	B 4
Pasewalk, 12,600	B 6
Perleberg, 13,600	B 4
Pirna, 40,400	C 5
Plauen [im Vogtland], 82,000	C 5
Potsdam, 117,600	B 5
Prenzlau, 20,000	B 5
Pritzwalk, 9,416	B 5
Quedlinburg, 33,100	C 4
Radeberg, 16,600	C 5
Rathenow, 29,400	B 5
Reichenbach [im Vogtland], 31,400	C 5
Riesa, 36,700	C 5
Rostock, 150,000	A 5
Rudolstadt, 27,000	C 4
Saalfeld, 27,200	C 4
Salzwedel, 21,800	B 4
Sangerhausen, 21,400	C 4
Sassnitz, 12,000	A 5
Schmalzkalden, 13,100	C 4
Schönebeck, 45,900	B 4
Schwedt, 5,961	B 6
Schwerin, 94,200	B 4

Sebnitz, 15,400	C 6
Senftenberg, 19,400	C 6
Sondershausen, 19,000	C 4
Sonneberg, 29,100	C 4
Spremberg [in der Niederlausitz], 22,500	C 6
Stassfurt, 26,800	C 4
Stendal, 39,100	B 4
Stralsund, 65,300	A 5
Suhl, 25,200	C 4
Tangermünde, 14,600	B 4
Templin, 11,100	B 5
Teterow, 11,300	B 5
Torgau, 20,400	C 5
Ueckermünde, 12,000	B 5
Waren, 19,900	B 5
Warnemünde (part of Rostock)	A 5
Weimar, 66,700	C 4

Weissenfels, 46,900	C 4
Werdau [in Sachsen], 25,400	C 5
Werneuchen, 4,218	B 5
Wernigerode, 34,200	C 4
Wismar, 54,800	B 4
Wittenberg, 48,100	C 5
Wittenberge [an der Prignitz], 32,000	B 4
Wittstock, 10,200	B 5
Wolgast, 13,400	A 5
Wriezen, 4,806	B 6
Wruzen, 25,200	C 5
Zehdenick, 13,300	B 5
Zeit, 45,900	C 5
Zella-Mehlis, 16,600	C 4
Zerbst, 18,100	C 5
Zittau, 46,100	C 6
Zossen, 5,958	B 5
Zwickau, 135,800	C 5

Physical Features

Aller R.	B 3
Alt Mühl R.	D 4
Alz R.	D 5
Ammer Lake	E 4
Amrum (Isl.)	A 3
Black Forest [Schwarzwald] (Mts.)	E 2
Bohemian Forest (Mts.)	D 5
Borkum (Isl.)	B 2
Brocken (Mtn.)	C 4
Chiem Lake	E 5
Constance Lake	E 3
Donau (Danube) R.	D 5
East Frisian Is.	B 2
Eder R.	C 3
Eifel (Mts.)	C 2
Elbe R.	B 4
Elde R.	B 4
Ems R.	B 2
Enz R.	D 3
Erzgebirge, see Ore Mts.	
Fehmarn (Isl.)	A 4
Fehmarn Strait	A 4
Feldberg (Mtn.)	E 3
Flensburger Fjord	A 3
Föhr (Isl.)	A 3
Fulda R.	C 3
Great Arber (Mtn.)	D 5
Harz Mts.	C 4
Hase R.	B 2
Havel R.	B 5
Helgoland (Isl.)	A 2
Hunsrück (Mts.)	D 2
Hunte R.	B 3
Iller R.	D 4
Ilmenau R.	B 4
Inn R.	D 5
Isar R.	D 5
Jade Bay	B 3
Jeetzel R.	B 4
Juist (Isl.)	B 2
Kadet Channel	A 4
Kiel Bay	A 3
Kocher R.	D 3
Lahn R.	C 2
Langeoog Isl.	B 2
Leine R.	D 4
Leine R.	B 3
Lippe R.	C 3
Lübeck Bay	A 4

Ludwig Canal	D 4
Main R.	D 3
Mittelland Canal	B 4
Mosel R.	D 2
Mulde R.	C 5
Müritz Lake	B 5
Naab R.	D 5
Nahe R.	D 2
Neckar R.	D 3
Neisse R.	C 6
Norderney (Isl.)	B 2
Nordstrand (Isl.)	A 3
North Frisian Is.	A 2
Oder R.	B 5
Odenwald (Mts.)	D 3
Ore Mts. (Erzgebirge)	C 5
Oste R.	B 3
Peene R.	B 5
Pegnitz R.	D 4
Pellworm (Isl.)	A 3
Randow R.	B 6
Rednitz R.	D 4
Regen R.	D 5
Rhein Canal	B 5
Rhine R.	C 2
Rothhaar (Mts.)	C 3
Rügen (Isl.)	A 5
Ruhr R.	C 3
Saale R.	C 4
Schwarzwald, see Black Forest (Mts.)	
Schweriner See (Lake)	B 4
Sieg R.	C 2
Spiekeroog (Isl.)	B 2
Spree R.	B 6
Stettin Lagoon	B 5
Stör R.	B 3
Sylt (Isl.)	A 3
Taunus (Mts.)	C 3
Thuringer Wald (Mts.)	C 4
Trischen (Isl.)	A 3
Ucker R.	B 5
Unstrut R.	C 4
Wager Lake	D 5
Wangerooge (Isl.)	B 2
Warnow R.	B 4
Werra R.	C 3
Wertach R.	D 4
Weser Canal	B 3
Weser R.	B 3
Westerwald (Mts.)	C 2
Wülm Lake	E 4
Zugsplitze (Mtn.)	E 4

Source: Latest available official figures. * Population of metropolitan area, including suburbs.
 * Place names marked by an asterisk do not appear on the map. Key shows general location.

passed on from mother to daughter. Many German dishes are eaten and enjoyed in the United States.

Cities. More than half the people in Germany live in towns and cities of more than 2,000 inhabitants. Berlin, Germany's largest city, has been divided into East and West Berlin since World War II. The Pankow section of East Berlin is the capital of East Germany. Bonn serves as the capital of West Germany. See the separate articles on German cities listed in the *Related Articles* section of this article.

Mining. The most important mines of West Germany are the soft-coal mines of the Ruhr region. These mines supply much of the coal needed for the iron and steel industry of all Western Europe. There are some iron mines in West Germany, but more than half the iron ore used in the country's industry is imported from France and Sweden.

Lignite, or brown coal, is mined from open pits in both West and East Germany. Its chief use is for generating electric power. Some of the world's largest potash mines are located in both West and East Germany. Common salt is taken from mines in the northern and western parts of Germany. Mines in the mountains of southern Germany produce silver, copper, zinc, lead, and nickel. Amber of excellent quality has been taken from the Baltic Coast of East Germany for more than two thousand years. Germany is now producing about a third of the petroleum it needs. East Germany has large uranium deposits. Uranium has also been discovered in West Germany.

Manufacturing. A great industrial area called the Ruhr has grown up around the cities of Duisburg, Dort-

mund, and Essen in West Germany. More than 5,000,000 people live in this area, where great iron and steel mills have been built near the rich coal mines. Near the iron and steel plants are manufacturing plants that make steel products, such as machine tools, fine tools, and knives. Production of small Volkswagen automobiles at Wolfsburg, West Germany, became one of the country's most important industries after World War II.

West Germany is one of the world's leading ship-building countries. Its huge shipyards are in its North Sea ports.

West Germany is the second largest chemical-producing country. This is because the country is rich in three resources often used to make chemicals: coal, potash, and salt. Great plants have been built for making drugs, medicines, fertilizers, dyes, plastics, synthetic fabrics, and industrial chemicals. German cameras and scientific instruments have long been famous for their accuracy. Solingen is the center of the cutlery industry. All sizes of clocks and watches are made in Germany.

The oldest industry in Germany is the manufacture of cloth, including cotton, woolen, silk, and linen textiles. Much of the raw wool, cotton, and silk for cloth must be shipped into the country. But flax for making linen grows in Germany.

The manufacture of sugar from sugar beets is an important and highly developed industry in Germany.

Many breweries use German-grown hops and malt to

A Hillside Farm in the Beautiful Black Forest Region of southwestern Germany. The Black Forest received its name

because of its dense forests of dark fir. This part of Germany is described in many old legends and fairy tales.

H. Armstrong Roberts





German Tourist Information Office

German Schools place great emphasis on healthful activities, such as gymnastics. In the modern schools, students are given training in such practical arts as cooking.

German Tourist Information Office



turn out thousands of gallons of beer each year. The grapes grown in Germany are made into wines, especially a light, clear type called Rhine wine.

Toymaking has been important in Germany for hundreds of years. Porcelain, glass, and pottery are made from clays and sand, together with the potash found in northern Germany. Other German industries include printing, map making, sausage making, the making of locomotives, and the production of leather and aluminum.

Agriculture. The farmers of West Germany supply only a little more than half of the food which the people of the country need. Before World War II, the farms of East Germany grew most of the grain, potatoes, meat, eggs, vegetables, and fruit used throughout the whole country.

The United States has helped to introduce modern agricultural methods into West Germany. Modern farming has helped increase food production. Most of the farms of Germany are small compared to the average farm in the United States. Many of these small farms still use the same methods and equipment used for hundreds of years, because it does not pay to use expensive farm machinery on small pieces of ground.

The chief crops grown in Germany include rye, wheat, barley, oats, potatoes, sugar beets, and hay. Other important crops are flax, hops, malt, corn, and such fruits as apples, pears, grapes, peaches, cherries, and plums.

Stock Raising. Much of the cleared land in Germany which is not farmed is used for grazing and pastureland for livestock. Partially drained marshlands are used as pastures for domestic animals. Hillsides that are too steep for farms sometimes are meadows for livestock. Germany has many pigs and cows but few sheep. Dairy and livestock products include meat, butter, and cheese. Poultry and eggs are mostly imported.

Fisheries. Food fish are abundant in the lakes and rivers of Germany. Fishing on the high seas is one of the important industries of the German seacoast cities.

Forestry is an advanced science in Germany. Men are trained to know the kind and number of trees that may be cut safely without damaging the forest growth of the country. New trees are planted to take the place of old trees that have been cut down. Hillsides are planted in trees to protect the soil and keep it from washing down the slopes. German forests produce much of the wood needed in the country for building, for firewood, and for making hand-carved objects. Wood pulp is imported from Sweden and Finland.

Transportation. Germany has a widespread network of roads, railroads, and water highways made up of rivers and canals wide and deep enough for boat travel. The Kiel Canal cuts across the peninsula of Jutland to connect the Baltic with the North Sea. The Mittelland (midland) Canal connects the Rhine with the Weser River, the Weser with the Elbe, and the Elbe with the lakes surrounding Berlin. There is also a canal connecting Berlin with the Oder River. Another important canal is the Dortmund-Ems Canal, which connects the Ruhr Basin with the North Sea by way of the Ems River. In the 1930's, a canal was built to connect the Main, a large eastern branch of the Rhine, with the Danube. In this way, the Rhine and the Danube were linked into one large waterway system.

Over 80,000 miles of roads and highways run between

the cities and towns of West Germany. A system of freeways and expressways, called the *autobahn*, was built during the 1930's and has been extended in West Germany since World War II. West and East Germany have over 32,858 miles of railroads. Commercial airlines provide air transportation.

Communication. Postal and telegraph service in Germany has been well developed under the control of the German government. All German cities and many of the towns have telephone service.

West Germany has over 3,700,000 telephones, over ten times as many as East Germany. West Germany has about fifty radio stations and several television stations.

Trade. West Germany is one of the world's leading trading countries. The country imports food and raw materials, such as iron ore, from other countries. It exports chiefly machinery, coal and coke, iron and steel, and other manufactured products. West Germany does a large part of its trading with the United States, The Netherlands, France, and Sweden.

East Germany has almost enough food for its own people. It exports lignite, potash, and uranium, but imports coal, iron, and steel.

The Tourist Industry is an important source of income in Germany. Over 4,000,000 tourists visit Germany each year. Some people come to view the beautiful scenery or to enjoy sports. Others come to visit museums, to attend universities, or to go to festivals such as trade fairs or the performances of Wagner's operas at Bayreuth.

Social and Cultural Achievements

Education. Germany for many years has stressed the importance of education. In 1914 almost every person in Germany was able to read and write. German progress in the development of the arts and sciences has been recognized throughout the world.

In West Germany, all children between the ages of six and eighteen must attend school. Most children attend a *Volksschule*, or elementary school, paid for by the separate state governments. When a child is in about the fourth or fifth grade, he is given a series of tests. If his grades show he can do advanced work, he may then go to an *Oberschule*, a modern high school which teaches modern languages, science, and mathematics; or to a *Gymnasium*, a classical high school where Latin and Greek are stressed. If the student's test grades show that he does not have the ability to become a scholar, he remains in the elementary school. Later he may go to a *Berufsschule*, a part-time vocational school, while he receives on-the-job training in a trade. West Germany has over 31,000 elementary and secondary schools.

In East Germany, the Communists control all education strictly, to teach Communist principles.

Many German universities were founded hundreds of years ago. Degrees from these universities, as well as from modern German universities, have been recognized in world-wide educational circles. Some of the oldest schools include the universities in Cologne, Heidelberg, Leipzig, and Rostock. All these were founded before 1420. The Free University of Berlin, founded in 1948, is one of the best-known modern universities. Other famous universities include the universities of Bonn and Munich.

Libraries. The earliest libraries in Germany were university libraries, established at Heidelberg in 1386, and



Ries, Black Star

German Craftsmen are noted for their skill. The artist, above, is painting flower designs on porcelain dinnerware. A woodcarver, below, shows examples of his intricate work.

Ries, Black Star



Varied German Architecture can be seen in Eschenheimer Gate Square in Frankfurt am Main. In the center is the modern Bayer House, headquarters of an aspirin company. At the right is the old Eschenheimer Tower, for which the square is named.

German Tourist Information Office



at Leipzig in 1409. At first these libraries were open only to students and professors. Later the public was allowed to use all university and state libraries. The Royal Library in Berlin was founded by Frederick William, the Great Elector, and was opened to public use in 1661. Other early city libraries were opened in Munich and Dresden. Many of the early libraries charged a fee for the use of books. One of the first free libraries was opened in Hamburg in 1529. The library movement became widespread in the 1800's.

Books containing ideas which did not agree with those of the Nazis were burned or banned when Hitler was in power. During World War II, German libraries suffered losses. After the war, the United Nations and the occupying powers helped restore West German libraries.

Arts and Sciences. Many Germans are counted among the world's great scientists, musicians, and writers. The findings of early German scientists, such as the astronomer Johannes Kepler and the mathematician Gottfried Wilhelm von Leibnitz, were as important in their time as the later discoveries of the physicist Wilhelm Roentgen, who perfected X rays, and the great modern physicist Albert Einstein.

Famous German writers include Johann Wolfgang von Goethe, Friedrich von Schiller, Johann Paul Richter, Arthur Schopenhauer, Georg Wilhelm Hegel, Immanuel Kant, Thomas Mann, and many others. Jacob and Wilhelm Grimm are well known for their collection of fairy tales. Germany has made many contributions to the music of the world through the works of such composers as George Friederick Handel, Johann Sebastian Bach, Ludwig van Beethoven, Richard Wagner, Franz Schubert, Robert Schumann, and Felix Mendelssohn.

The most famous German painters date back to the 1400's and 1500's. These included Albrecht Dürer,

Lucas Cranach, and the two Holbeins. There have been many modern German painters of portraits, landscapes, and scenes from peasant life. There also have been bold experimenters in modern art.

The pictures with this article show that German architects have designed many beautiful buildings. Some of these outstanding buildings include mountain castles on the Rhine, town halls and guildhalls in the older cities, country inns, and Gothic churches. The great cathedral at Cologne is one of the most famous of Europe's many cathedrals and churches. See COLOGNE.

German craftsmen are as skilled in the making of hand-carved wooden objects and delicate glass and china articles as they are in the building of great motors and machines. German toymakers create tiny dolls and tops and wooden toys from the wood of native trees.

Some German wood carvers fashion intricate designs on cases for clocks. Other German craftsmen finish the delicate mechanism of clocks and watches. Germans have long been leaders in the making of optical and scientific instruments which require precise workmanship. German silversmiths beat heavy and ornate designs into objects made of silver. German craftsmanship in glassware, chinaware, and pottery is recognized and admired throughout the world.

Many German achievements are described in ARCHITECTURE; DRAMA; GERMAN LANGUAGE; GERMAN LITERATURE; MUSIC; OPERA; PAINTING; SCULPTURE.

Religion. Germany has several religious faiths. Roman Catholicism was the religion in all German lands until the 1500's, when about half the Germans adopted the beliefs of the Protestant Reformation. Most of the Protestants followed the teachings of Martin Luther and were known as Lutherans. Some of the Protestants followed the French Protestant reformer

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John Calvin, and organized Reformed or Evangelical churches. Many of the Polish-speaking people in eastern Prussia kept the Roman Catholic faith. So did the people of Austria, Southern Germany, and many of the Rhineland cities of western Prussia. Most of Prussia, Saxony, and north and central Germany became Protestant.

Freedom of religion was not allowed after the National Socialists came into power in 1933. The Nazis promised to promote what they called *positive Christianity*. But this turned out to mean persecution of the Jews and forcing all established Protestant churches to unite under direct government control. There was a movement to establish a kind of nature worship, to be known as the *German religion*. People of Jewish descent were killed or driven from Germany. Many Protestant ministers and Roman Catholic priests were thrown into jail or concentration camps when they protested the anti-religious activities of the Government.

Freedom of religion was restored in West Germany after World War II. In East Germany, religion is restricted by the Communist Government.

Recreation. German boys and girls are fond of both outdoor and indoor sports. They like to swim in the lakes and rivers, and to paddle light canoes in the swift currents of rushing streams. When the weather is pleasant, German youths take long walking or hiking tours, with small packs of provisions strapped on their backs. They camp in the open, cook supper over a camp fire, and sleep on the ground. In some places, camping cen-

ters maintain *hostels*, or cabins, which the campers may use for overnight stops. See **YOUTH HOSTEL**.

Many German sports and games are organized activities which call for close teamwork. German boys like to play association football, which is somewhat like American soccer. Both boys and girls take part in group gymnastics or calisthenics. At athletic festivals, large groups perform exercises with great precision.

Other German games call for individual skill. Fencing has long been a popular sport in Germany. Years ago a scar left from a sword cut in fencing was considered a mark of honor, especially among the boys of college age. Skiing, ice skating, and tobogganing are popular winter sports with boys and girls in Germany.

Grownups in Germany like music and dancing. They spend many summer evenings in gardens or open-air restaurants, where they gather around tables to eat and drink and sing the old songs.

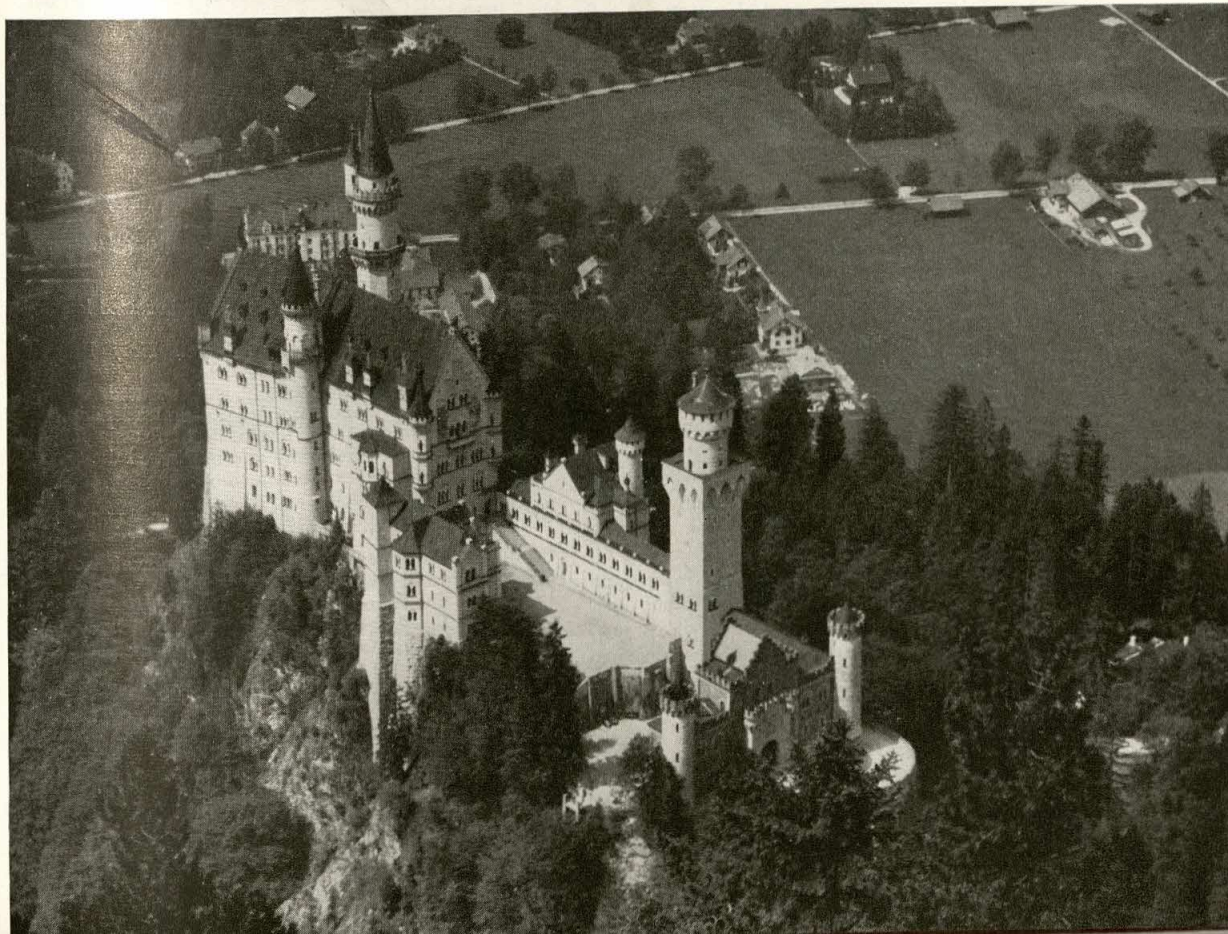
Festivals and fairs are popular in Germany. Often the people of villages and small communities celebrate saints' days or feast days by dressing in medieval costumes and performing some of the old ceremonies of worship or merrymaking. Many of them perform German folk dances.

Government of West Germany

Federal Government. West Germany is a constitutional democracy in which the people elect their repre-

Neuschwanstein, a Fairy-Story Castle, Was Built by King Ludwig II of Bavaria in the Middle 1800's.

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sentatives by secret ballot. The national government is a cabinet system, like that of Great Britain. The head of state is a president elected by a special convention every five years. The president appoints as *chancellor* the man who secures a majority vote in the Bundestag. The chancellor then selects his cabinet. The chancellor and the cabinet formulate and carry out government policy. The chancellor remains in office until the legislature elects a successor.

The constitution limits the powers of the federal government. Federal laws are passed by the elected legislature, or Bundestag, and then are submitted to the upper house, or Bundesrat, whose approval is necessary for many important, but not all, laws. The two most important political parties in West Germany are a middle-of-the-road party called the Christian Democratic Union, and the Social Democratic party.

The Supreme Court and the Supreme Constitutional Court are located in Karlsruhe.

State and Local Government. West Germany is truly a federal government. The states have their own constitutions and governments, much as do the states in the United States. Each state has an elected legislature, or *Landtag*, with a *minister president* and cabinet responsible to it. However, the state parliaments have power only in matters in which the federal Diet does not legislate. In the counties, towns, and cities, the voters elect their own councils, and sometimes their own mayors.

Government of East Germany

The Communist government of East Germany is a dictatorship modeled after that of Russia. The capital is in the Pankow section of East Berlin. The government pretends to be democratic and goes through the motions of having "elections." But the voters are not allowed to vote by secret ballot, and they must vote only for the candidates chosen by the Communist party. In 1952, the Communists abolished the historic provinces of East Germany and established 14 smaller districts in their place. These districts are closely administered by the central government.

History

Early Germany. A Teutonic people wandered through the forests of northern Europe for hundreds of years before their history was written. Their tombs and such relics as weapons and tools show something of their way of life. The first written account of the people of early Germany appeared after they made war against the soldiers of the Roman Republic. A German tribe known as the *Teutones* was defeated by the armies of the Roman general Marius in 102 B.C. Julius Caesar led his armies against German tribes in Switzerland (*Helvetia*), and against Germans along the Rhine.

The Roman emperor, Augustus, tried to conquer all Germany. His armies, under Varus, were defeated by German warriors led by Arminius, in the year A.D. 9. After this defeat, the Romans contented themselves with holding the river lines of the Rhine and the Danube against the raids of various Teutonic tribes, such as the Alamanni, Franks, Goths, Vandals, and Lombards.

Julius Caesar described some of the customs of the

early Germans in his book on the *Gallic Wars*. The Roman historian Tacitus, in his book *Germania*, told of Germany as it was about a hundred years after the birth of Christ.

The Roman accounts tell that the ancient German people were tall and very fair. These people lived in tribes and counted their wealth in flocks and herds of animals. They were fond of drinking and gambling, and left even the field work for their women. In the Roman accounts, the Germans are described as dressed in coarse cloth and animal skins, wearing armor of leather and metal. They used spears, swords, and battle-axes made of metal and stone. They worshiped their gods outdoors, in the great forests. The Germans hated towns and cities, and left waste lands between one tribe and another to reduce the chances of neighborhood quarrels. They are described as brave in battle, loyal to their chiefs, and faithful to their wives.

Some tribesmen were of noble birth and some were common freemen. But both classes usually shared in the assemblies of the warriors when important decisions were to be made. There were a few slaves in Germany but they did not represent a special class. The slaves were persons who had been captured in battle, who had gambled away their freedom, or who had sold themselves for food during famine times.

Invasion of the Roman Empire. German tribes poured like a torrent over the Roman Empire when Roman power began to weaken. The Germans were driven by their own greed and lust for power, and also by the attacks of wild horsemen from Asia who were called

RED-LETTER DATES IN GERMANY

- 58-55 B.C. Julius Caesar campaigned against the Germans.
- A.D. 9 Germans under Arminius destroyed a Roman army, ending Rome's plans to annex Germany.
- c.376-600 German invaders conquered Rome's western provinces.
- 800-1806 The First Reich (Empire) begun by Charlemagne and renewed in 962 by Otto.
- 1519 Protestant Reformation began, splitting Germany along religious lines.
- 1618-1648 Thirty Years' War.
- 1740-1786 Frederick the Great of Prussia seized leadership of Germany from Austria.
- 1792-1815 Napoleonic wars destroyed Holy Roman Empire.
- 1814-1866 Germany was loosely confederated, with a Diet of local princes under Austria leadership.
- 1866-1867 Prime Minister Bismarck of Prussia forced Austria out of Germany and organized the North German Confederation.
- 1870 Franco-German War.
- 1871-1918 The Second Reich, ruled by the Hohenzollerns.
- 1914-1918 World War I, ending in the downfall of the Hohenzollerns.
- 1918-1933 The Weimar Republic.
- 1933-1945 Third Reich, with Adolf Hitler dictator.
- 1939-1945 World War II, ending in downfall of Nazi dictatorship.
- 1949 Separate governments were set up in West and East Germany.
- 1955 West Germany became independent.
- 1956 West Germany began its rearmament program.
- 1957 The Saar district was returned to West Germany.
- 1958 Russia proposed that East and West Berlin be united into a free city.

the Huns. These fierce invaders were pushing into Europe from the east.

The German tribe of Goths spread over Italy and Spain. The Vandals moved west as far as southern Spain and northern Africa. The Lombards created Lombardy in the valley of the Po River, and the Angles and Saxons raided and settled Britain, giving it the name *Angleland*, or England. The Franks moved from the lower Rhine into Gaul and built up the largest and strongest of the new German kingdoms, which was later known as France.

The German tribes settled down among the conquered Roman citizens, intermarried with them, learned their civilization, and often adopted their language and customs. The German invaders were numerous enough to keep their old Teutonic speech in only a few places, such as England. But the old language and customs continued in the original German homeland, between the Rhine and the Elbe rivers. A related Teutonic people lived north of the Baltic in Scandinavia.

Kingdom of the Franks. A Frankish ruler named Clovis opened the gate of Roman civilization to his warriors by accepting Christianity and other Roman customs. The greatest Frankish ruler was Charlemagne, who came to the throne in A.D. 768. Charlemagne, whose name means *Charles the Great*, conquered the heathen Saxons and made them accept Christianity. He forced the Lombards to stop their attacks on the Pope at Rome. A grateful Pope crowned Charlemagne as Roman Emperor in A.D. 800.

As Emperor, Charlemagne ruled the countries which are today France, Germany, The Netherlands, Belgium, Austria, northern Italy, Switzerland, and a small part of eastern Spain. In those days, Germany and France were one country.

Charlemagne was Frankish and of German ancestry, but his subjects were about equally divided between those who spoke mainly Germanic dialects and those who spoke mainly Latin dialects, which later became French, Italian, and Spanish.

Breaking Up of Charlemagne's Empire. Charlemagne's great empire broke up in the days of his grandchildren. Charles the Bald got the western part of the empire, which became the Kingdom of France, by the terms of the Treaty of Verdun, signed in A.D. 843. The eastern part of the empire went to Louis the German. The central part, extending from The Netherlands to central Italy, was ruled by Lothair, for whom the province of Lorraine was later named.

The separate kingdoms formed from Charlemagne's empire lacked strength and political authority. Now and then a ruler arose who exerted enough power to restore some semblance of law and order to his kingdom. Such a king was Henry the Fowler of Saxony, who ruled from 919 to 936. He was followed by another strong ruler, Otto the Great, who in 962 again claimed the title of Roman Emperor.

The Holy Roman Empire of the German Nation. The Roman Empire controlled by Otto differed from that ruled by Charlemagne because it no longer included France. By the 1200's it came to be known as the Holy Roman Empire. The empire was little more than a loose league of princes and nobles in Germany and northern Italy.

Many of the Holy Roman Emperors lost sight of the

interests of their German-speaking subjects in their efforts to dominate Italy. The emperors were elected for life by a group of electors which varied in number but was for a long period fixed at seven. There was also a diet of rulers and, after 1300, of deputies from cities, but it was more like a diplomatic conference of independent nations than an ordinary lawmaking body.

The Holy Roman Empire was weakened by quarrels between the church and the state. Civil wars broke out in Germany and northern Italy between the followers of the Pope, called the Guelphs, and the followers of the emperor, called the Ghibellines. Many Italian cities took sides with the Pope because they wanted to shake off the control of the Roman Empire. This struggle was especially bitter under the Salian Emperors Henry III and IV, and under the Hohenstaufen Emperors Frederick Barbarossa and Frederick II.

All Germany fell into disorder and confusion soon after the death of Frederick II, and for several years no emperor was elected. In 1273 Rudolph of Austria, the first of the rulers from the Hapsburg family, was chosen emperor. Under his rule, Austria began its rise to power. See HOLY ROMAN EMPIRE.

Germany in the Middle Ages. Some of the great German trading cities on the North and Baltic seas found the Holy Roman Empire too weak to protect them from the attacks of the sea pirates. In the 1200's, they joined together in a military and naval alliance known as the Hanseatic League, formed for the purpose of self-protection and to promote trade. The Swiss mountaineers also formed a confederation of their own. See HANSEATIC LEAGUE; SWITZERLAND.

German cities in the 1200's to 1500's were small, dirty, and unsanitary. But they had magnificent churches and cathedrals, and many of their guild houses and private homes were quaint and picturesque. They were busy places, with showy public festivals, fairs, and saints' day celebrations. In the cities, a poor man had an opportunity to rise to wealth and power as a merchant. The feudal class distinctions were not so strict.

Country life was less attractive. Most peasants were practically slaves, and many rural laborers were bound to stay on their landlord's estate as serfs. Life in the grim, stone-walled castles of the knights and nobles was less comfortable than life in the cities. But the noblemen looked with aristocratic scorn on the city tradesmen.

German Wars of Religion. The Germany of the early 1500's was largely controlled by the Hapsburg family of Austria. One of the Hapsburgs was usually chosen emperor. The Hapsburgs took their power not so much from their position as emperors as they did from the vast variety of lands which had gradually come into the family by marriage and inheritance. Charles V (1519-1556) ruled by various titles in Austria, Spain, Burgundy, The Netherlands, and several parts of Italy. His rule in Germany was interrupted because he was frequently called out of the country by disturbances in his other possessions.

The authority of Charles V was also weakened by a religious disagreement which broke out in Germany. Martin Luther attacked the teachings and practices of the Roman Catholic Church. Many persons immediately accepted his teachings of Protestantism. Powerful

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princes took up Luther's cause of Protestantism, and neither the Pope nor the emperor was able to crush the movement. The Peace of Augsburg, signed in 1555, gave Lutheran and Catholic princes an equal right to establish their own forms of worship in their dominions. See CHARLES (V) of the Holy Roman Empire; LUTHER, MARTIN; REFORMATION.

The peace between Catholics and Protestants lasted for sixty-three years in the Holy Roman Empire. But all the causes of war remained. The Catholic Church was not able to force the Catholic bishops and abbots who became Protestants to give up the lands they held. The Protestant Germans were against any move to make the empire stronger, because the emperors were Catholics.

The Hapsburg family, under Ferdinand I, won Bohemia and Hungary. Trouble broke out in Bohemia in 1618, when the Austrian Hapsburg Ferdinand II, a strong Catholic, was opposed by the Protestant party.

The Thirty Years' War. The trouble in Bohemia started in 1618 as a religious conflict and developed into a war which lasted thirty years and laid waste all Germany. Most of the nations in Europe entered the war for their own interests. Germany was the battlefield where Catholic Austria, often allied with Spain, fought the Protestant Danes, Swedes, and Dutch. Catholic France entered the war to fight against Catholic Austria, putting the interests of the kingdom of France above those of the Church.

The Thirty Years' War ended with the Peace of Westphalia, signed in 1648. The treaty took away almost all the emperor's power, and gave to Sweden and France towns and provinces torn from the empire. It left Germany nearly helpless, open to the attack of tyrants at home and robber kings from other countries. Historians estimate that more than half of the population of Germany had been killed or had starved to death during the years of war. See THIRTY YEARS' WAR.

The Rise of Prussia. The Kingdom of Prussia began its rise to power and greatness during the time of the Thirty Years' War. The story of the rise of Prussia is the history of the rise of the Hohenzollern family.

The Hohenzollerns were recognized as the strongest rulers in northern Germany after 1640 when Frederick William, the Great Elector, came to the throne of Brandenburg, a district around Berlin. The Elector used war and diplomacy to create a combined Brandenburg-Prussian state, protected by a strong army.

The next ruler of Prussia, Frederick I, took the title of King of Prussia in 1701. The Prussian king still owed allegiance to the emperor, but the rivalry between the two rulers was growing increasingly bitter. King Frederick William I of Prussia (1713-1740) took strict economy measures to fill the Prussian treasury, and selected tall, capable soldiers from many countries, to create the best-disciplined army in Europe.

Frederick II, often called Frederick the Great, used the army and treasury that his father had built up to make Prussia one of the great powers of Europe. He began his reign in 1740, the same year in which the Holy Roman Emperor Charles VI of Austria died. Charles VI had left all the Hapsburg family territories to his daughter, Maria Theresa. Frederick started his warlike

career by seizing the province of Silesia from Austria.

In 1756 Maria Theresa organized an alliance made up of France, Sweden, Russia, Saxony, Austria, and other countries, and set out to punish Frederick for taking Silesia. The Seven Years' War (1756-1763) which followed ended in complete victory for Frederick, although he fought against half of Europe and had no important allies except the British. Prussia not only defeated Austria, but later took part of Poland.

Germany and Napoleon. Most of the German states, including Austria and Prussia, became involved in the wars of the French Revolution after 1792. Napoleon carried the French wars deep into Germany. He abolished the Holy Roman Empire in 1806, and seized parts of Austria and Prussia. He forced the people of the German states along the Rhine to become either French subjects or French allies. He reorganized the west German states into a Confederation of the Rhine under his protection.

After a time the Germans rebelled against French oppression. A patriotic movement began under the leadership of such men as Baron Heinrich vom und zum Stein. The leaders took steps to abolish serfdom and create local self-government in Prussia. General Gerhard von Scharnhorst and Count August von Gneisenau established a new Prussian system of universal military training. Prussia played a large part in the defeat of Napoleon at Leipzig and later at Waterloo.

The German Confederation. German patriots who hoped for a united Germany were disappointed at the peace conference held in Vienna in 1814-1815. Austria would not join with the German states to form a national union of Germany. Austria feared it would lose its power if it became a member of such a union.

As a result of the conference, Prussia took part of Saxony and certain lands along the Rhine, and Austria got Venice and Lombardy in northern Italy. The more than three hundred independent states in the old Holy Roman Empire were reduced to thirty-eight. A German *Bund*, or Confederation, was established in place of the empire. The *Bund* was merely a league of German rulers. Each German state had its own flag and armies, levied its own taxes and tariffs, and wrote its own constitution and laws. The *Bund* was not controlled by an emperor or ruler, but depended on a diet, or council, of diplomatic delegates from independent rulers to keep peace and order among the states.

The Unification of Germany. Revolutionary movements for German union and liberty broke out in 1848 and 1849. A national parliament met at Frankfurt to make a constitution for a federal German empire headed by Prussia. But the king of Prussia refused to become the German emperor, partly from hatred of the revolution and partly from fear of Austrian opposition. The old *Bund* was restored, and thousands of German liberals went to the United States to seek personal freedom.

Prussia was well suited to assume the leadership of the German states. It had a very strong army, a well-organized administration, and a spirit for German nationalism and unity. The further qualifications of a strong ruler and a brilliant statesman were added in 1861, when King Wilhelm I came to the throne of Prussia and chose Count Otto von Bismarck-Schönhausen as his chief minister.

Bismarck placed Prussia at the head of the movement



The Principal States of Germany in the 1860's, Before They Joined to Form the German Empire.

for German unity. He dismissed the Prussian parliament, threw out the constitution, and enlarged the Prussian army. He sent the new Prussian army against Denmark, and annexed the Danish provinces of Schleswig and Holstein. He attacked Austria in the Seven Weeks' War of 1866, and took over Hannover and some other North German states at the end of the struggle. In 1867 Bismarck thrust Austria completely out of German affairs and abolished the German Bund in favor of a new North German Confederation. The new Confederation was smaller than the old, but it had a much stronger central government. The King of Prussia served as president of the Confederation.

The French, under the leadership of Emperor Napoleon III, were alarmed at the rapid rise of Prussia to German leadership. France was maneuvered into a war on Prussia when it looked as though a member of the Hohenzollern family might be chosen to fill the vacant Spanish throne. Prussia won an easy victory over France, and took the provinces of Alsace and Lorraine.

The United Empire. A new German Empire, or Second Reich, grew out of the victories of the Franco-Prussian War and a newly awakened German nationalism. The Empire included the North German Confederation and the south German states of Baden, Württemberg, Bavaria, and Hesse-Darmstadt.

The new German Empire was a federation headed by the King of Prussia, who took the title *Deutscher Kaiser*, or German Emperor. The Kaiser appointed a

Chancellor to look after the details of government. The legislature was made up of two bodies, the upper house or Federal Council (*Bundesrat*), and the lower house or Imperial Diet (*Reichstag*). The upper house was made up of representatives of the rulers of the German states. The lower house was elected directly by universal manhood suffrage, but had very little power.

The new Germany was only about half the size of the old Holy Roman Empire, but it was more nationally German and much more strongly united. Bismarck, as Chancellor, made alliances with Austria-Hungary in 1879 and Italy in 1882. He kept on good terms with Russia and Britain, and obtained colonies in Africa and in the Pacific. He established a protective tariff to build up German industries, and had laws passed for old-age pensions and government insurance, to make certain that the working class would be loyal to the Government.

Emperor Wilhelm I died in 1888, and was succeeded by his son Frederick III and his grandson Wilhelm II in the same year. Wilhelm II dismissed Bismarck in 1890, and insisted that later chancellors build up a large German army and navy. Wilhelm alarmed the British by his military policy, lost the friendship of Russia, and made enemies on every side. But the growth of Germany's industries made the nation more powerful.

Germany in World War I. The immediate cause of World War I was the assassination of the Austrian Archduke Francis Ferdinand at Sarajevo in Bosnia, on June 28, 1914. When Austria-Hungary declared war on Ser-



German Empire Before World War I



German Republic After World War I

bia, Russia protested and mobilized an army along the frontiers of Austria and Germany. Germany then declared war on Russia and on Russia's ally, France.

Germany moved to conquer France before Russia could make ready for war. German troops marched toward Paris through two small neutral countries, Luxembourg and Belgium, even though Germany was bound by special treaty agreement to respect their neutrality. Great Britain protested this violation of neutrality and entered the war against Germany. German armies overran Belgium and northern France, but French and British forces held along the line of the Marne River.

Germany and three allies, Austria-Hungary, Bulgaria, and Turkey, formed a group called the Central Powers. They dominated Central Europe and Western Asia from the North Sea to the Persian Gulf, but were hemmed in on every side by enemy land or sea forces. The Germans forced Russia to surrender, but could not break the French lines.

The United States was brought into the conflict by the actions of German submarines, and declared war against Germany on April 6, 1917. By 1918 Germany's allies were exhausted and Germany was no longer able to bear the full weight of the struggle. Germany surrendered to the victorious Allies on November 11, 1918. The German Emperor fled to The Netherlands, and the German Empire came to an end. See **WORLD WAR I**.

Under terms of the Treaty of Versailles, Germany lost all former colonies. These included the African territories of Togoland, Kamerun, Southwest Africa, and Tanganyika; Kaiser Wilhelmsland in New Guinea; a number of small islands in the Pacific, including Samoa, the Bismarck Archipelago, and the Carolines; and the Chinese port of Kiaochow. Germany also gave land to France, Poland, Denmark, Belgium, Lithuania, and Czechoslovakia in Europe. The German Army was limited to 100,000 men, and reparations were fixed at about \$33,000,000,000.

The Weimar Republic. A period of unrest followed the surrender. Then in 1919 the people of Germany elected a National Assembly which met at Weimar and drew up a republican constitution. The new government provided for a president elected directly by the people, and a ministry responsible to the lower house, or Reichstag. But the republic was attacked by three opposing groups within Germany. The monarchists

wanted to restore the empire. The Communists wanted a dictatorship in the Russian style. The National Socialist, or Nazi, party demanded a dictatorship, the rearming of Germany, and the tearing-up of the Treaty of Versailles. The National Socialists were headed by an Austrian war veteran, Adolf Hitler.

Friedrich Ebert was the first president of the German Republic, and was followed in 1925 by Field Marshal Paul von Hindenburg, who favored a return to the old monarchy. Germany suffered from an almost unbelievable inflation of paper money, but in 1925 the Dawes Plan enabled Germany to start a new currency system. It also regulated payment of reparations so that it would not exceed ability to pay. In 1925 Germany made a peace pact with the British, French, Italians, and others at Locarno, and in 1926 Germany joined the League of Nations. The Young Plan took the place of the Dawes Plan in 1929, and made reparations payments still easier. In 1931 President Hoover suspended for one year all payments on war debts and reparations, and in 1932 the Lausanne agreement cut Germany's debt to almost nothing.

The world depression settled on Europe, and unemployment in Germany became general. The people were hungry and desperate, and were ready to listen to Hitler and the Nazis.

Nazi Germany. President von Hindenburg was re-elected in 1932. In 1933 he appointed Adolf Hitler Chancellor, or Prime Minister, of Germany. In March, 1933, Hitler established one of the most absolute dictatorships of modern times. President von Hindenburg died in August, 1934, and Hitler abolished the presidency. He created the title of *Leader*, or *Fuehrer*, for himself. Hitler decreed laws at Nuremberg in 1935 to exclude all Jews from German citizenship, and to deprive them of property rights and legal protection. During the next ten years, Hitler's campaign led to the killing of millions of Jews. Christians who openly opposed Nazi ideas also were persecuted. See **HITLER, ADOLF; NAZISM**.

Hitler withdrew Germany from the League of Nations in 1933. In 1935 he revived compulsory military training. In 1936, he sent troops into the Rhineland to set up a barrier against France, and made an alliance with Italy to form the Rome-Berlin Axis.

In March, 1938, Hitler seized peaceful Austria and annexed it to Germany. He demanded that Germany



Nazi Germany at Beginning of World War II



Germany After World War II

be given the Sudetenland, which was the German-speaking mountain district of Bohemia in Czechoslovakia. The British and French consented to his demands in Czechoslovakia, and a peace pact was signed at Munich in September, 1938, by Great Britain, France, Italy, and Germany.

Hitler seized the rest of Czechoslovakia in March, 1939. Next he took the little district of Memel from Lithuania. In August, 1939, Germany and Russia signed a nonaggression pact, as allies.

Germany and World War II. German forces entered Poland on September 1, 1939, and quickly conquered the country. At the same time Russia occupied the eastern provinces of Poland. Because of this aggression, Great Britain and France declared war on Germany on September 3. See **WORLD WAR II**.

Early in 1940, Germany occupied neutral Denmark and invaded Norway. German troops conquered the small neutral countries of The Netherlands, Belgium, and Luxembourg. Italy entered the war on Germany's side. France surrendered in June, 1940, and British troops withdrew from continental Europe.

In the spring of 1941, Hitler seized the Balkan Peninsula, and struck without warning deep into Russia. German armies were halted at Moscow and Leningrad during the winter of 1941.

Germany's partner, Japan, attacked the American fleet at Pearl Harbor on December 7, 1941. Three days later, Germany declared war on the United States.

Germany gradually went down to defeat during the years 1943 and 1944, and was invaded in the spring of 1945. On May 1, 1945, Admiral Doenitz announced that he had been appointed Hitler's successor. Hitler, it was believed, had committed suicide. Doenitz agreed to an unconditional German surrender on May 7, 1945.

After World War II. Defeated Germany was divided into four military zones, which were occupied by American, British, French, and Russian troops. The city of Berlin, located in the heart of the Russian Zone, also was divided into four occupation sectors. The territories Hitler had seized from other countries were taken from Germany. Austria was declared independent. The Saar was given autonomous, or nearly independent, status under French economic administration.

In violation of the Potsdam agreement, Russia annexed the northern part of East Prussia. Its satellite, Poland, also violated the pact by taking the areas east

of the Oder and Neisse rivers. Germans of that region were moved west of the Oder River.

Many war industries were dismantled. Russia moved entire German factories from Germany to Russia. Many of the Nazis responsible for war crimes were tried by courts and punished. See **NUREMBERG TRIALS**.

Russia soon made it clear that it planned to delay as long as possible any final peace treaty that would unify Germany. As a result, France, Great Britain, and the United States began to re-educate the German people in their own zones and help rebuild the economy to make West Germany ready to accept the responsibilities of democracy. In contrast, Russia rigidly controlled its zone as a Communist police state. In 1947, the British and American zones in Germany were united. In June, 1948, the three Western Powers (Britain, U.S., France) issued a new common currency for their zones in Germany and their sectors of Berlin, to end inflation and the black market. Then Russia issued a new currency for its zone. It was based on a much lower exchange rate. The two currencies caused trouble in Berlin, and Russia imposed a blockade of West Berlin, which lasted eleven months. The Western Powers fed and supplied the two million persons in their sectors of Berlin solely by plane during this time. See **BERLIN (History)**.

West Germany. The Western Allies gave permission to the West Germans to organize a constitutional assembly, which met in Bonn in 1948. The assembly drew up a new republican constitution, called the Basic Law. This constitution went into force in May, 1949, creating the West German Federal Republic. This West German government was given almost complete independence. The military governors of the Western Powers were replaced by civilian high commissioners.

The first president of the new republic was Theodor Heuss (1884-). However, the most important government leader was Konrad Adenauer, who presided over the constitutional assembly and became West Germany's first chancellor. One of the problems of the new government was providing for over 10 million refugees from East Germany and other Communist countries.

West Germany became a part of such international organizations as the European Payments Union, the Council of Europe, and the European Coal and Steel Community. On May 5, 1955, the United States, Great Britain, and France signed treaties with West



H. Armstrong Roberts

The Moat and Wall of the ancient town of Dinkelsbühl originally helped to protect the townspeople.



H. Armstrong Roberts

The Fortified Gateway of the Old City of Lübeck was built in the 1400's, when Lübeck was one of the greatest ports of Europe.

GERMAN ARCHITECTURE OF THE MIDDLE AGES



German Tourist Information Office

Town Hall of Frankfurt am Main was built about 1410. It was badly damaged during World War II, but was restored, with a new clock, after the war.



H. Armstrong Roberts

In Rothenburg ob der Tauber, it is illegal to change the architecture of any of the medieval buildings.

GERMANY

Germany, making it an independent country again. Shortly thereafter, West Germany joined the North Atlantic Treaty Organization and the Western European Union. The country started a rearmament program in 1956 that allowed for a force of 150,000 men. The United States maintains 12 air force bases in West Germany. National elections in 1957 gave Chancellor Adenauer's Christian Democrats a majority in the Bundestag. The Saar district was returned to West Germany in 1957. In 1959, Heinrich Lübke succeeded Theodor Heuss as president. In 1961, West Germany began an aid program for underdeveloped countries.

East Germany. Meanwhile, in the Russian Zone of Germany, the communists set up a dictatorship and ruled the people with secret police. They set up the capital at Pankow, a section of East Berlin. About 20,000 East Germans fled to West Germany every month. On June 17, 1953, workers in East Berlin rioted against the harsh conditions in East Germany, but the uprising was put down by Russian troops. In 1953, the United States supported a food-giveaway program in West Berlin for East Germans. In 1954, the Russian government made East Germany an independent state with the power to conduct its own internal affairs. In 1955, Russia recognized East Germany as a sovereign state with power to conduct its own foreign affairs. But the Western Powers refused to recognize it as such. In 1958, Russia proposed that East and West Berlin be united as a free city. The Western Powers refused to agree to Russia's proposal. East Germany's chief officials are Council of State chairman Walter Ulbricht and Prime Minister Otto Grotewohl. JAMES K. POLLOCK

Related Articles in WORLD BOOK include:

BIOGRAPHIES

See the list under Germany in the BIOGRAPHY section of the READING AND STUDY GUIDE.

CITIES AND TOWNS

Aachen	Erfurt	Leipzig
Augsburg	Essen	Lübeck
Baden-Baden	Frankfurt am Main	Magdeburg
Bayreuth	Frankfurt an der Oder	Mainz
Berchtesgaden	Halle	Mannheim
Berlin	Hamburg	Munich
Bonn	Hannover	Nuremberg
Braunschweig	Heidelberg	Oberammergau
Bremen	Jena	Potsdam
Chemnitz	Karlsruhe	Rostock
Cologne	Kassel	Stuttgart
Dortmund	Kiel	Trier
Dresden	Koblenz	Wiesbaden
Duisburg	Krefeld	Worms
Düsseldorf		

HISTORY

Algeciras Conference	Franco-Prussian War
Alsace-Lorraine	Frank
Aryan	Genoa Conference
Augsburg Confession	Guelphs and Ghibellines
Axis	Hanseatic League
Balance of Power	Hapsburg
Berlin, Congress of	Hitler, Adolf
Brunswick (family)	Hohenstaufen
Dawes Plan	Hohenzollern
Euromarket	Holy Alliance
Europe, Council of	Holy Roman Empire
European Coal and Steel Community	Kaiser
European Monetary Agreement	Locarno Conference
Feudalism	Memel, Territory of
	Nazism

Peasants' War
Prussia
Reformation
Reichstag
Revolution of 1848
Saar
Schmalkaldic League
Seven Weeks' War
Seven Years' War
Succession Wars

Teuton
Thirty Years' War
Triple Alliance
Vandal
Verdun, Treaty of
Vienna, Congress of
Warsaw Pact
World War I
World War II
Zollverein

PHYSICAL FEATURES

Alps	Lake Constance	Ruhr River
Black Forest	Main River	Spree River
Danube River	Moselle River	Sudetes Mountains
Elbe River	Oder River	Thuringian Forest
Harz Mountains	Rhine River	Weser River
Kiel Canal		

PRODUCTS

For Germany's rank among other countries in production, see the following articles.

Aluminum	Lumber	Rye
Barley	Manufacturing	Silver
Cheese	Oats	Sugar
Coal	Paper	Sugar Beet
Fishing Industry	Potato	Textile
Leather	Publishing	

STATES AND REGIONS

Bavaria	Hesse	Saxony
Brandenburg	Mecklenburg	Schleswig-Holstein
Brunswick	Palatinate	Thuringia
Hanover	Pomerania	Westphalia
Helgoland	Ruhr	Württemberg

UNCLASSIFIED

Army (Major Armies)	Gauleiter
Biedermeier	Geopolitics
Burgomaster	German Language
Christmas (In Germany)	German Literature
Clothing (color picture, Europe)	Heidelberg, University of
Deutschland Über Alles	Mouse Tower
Easter (In Germany)	Reichswehr
Fairs and Expositions	Ship and Shipping (table)
Food (Favorite National Foods; Kinds)	Wehrmacht
Free City	

Outline

I. The Land and Its Resources

- Location, Size, and Surface Features
- Rivers, Lakes and Bays
- Natural Resources
- Climate

II. The People and Their Work

- The People
- Cities
- Mining
- Manufacturing
- Agriculture
- Stock Raising
- Fisheries
- Forestry
- Transportation
- Communication
- Trade
- The Tourist Industry

III. Social and Cultural Achievements

- Education
- Libraries
- Arts and Sciences
- Religion
- Recreation

IV. Government

V. History

Questions

Is the Black Forest really a forest?
Into what two parts is Germany divided today?
Why is each of these men important in German history:
Charlemagne, Hitler, Konrad Adenauer?
How have the Germans made it possible for much of their traffic to travel by water?
Where is the farming area of Germany?

GERMICIDAL LAMP

GERMICIDAL LAMP is a lamp used to *disinfect*, or kill bacteria in the air. It is used to sterilize the air in hospitals, nurseries, and operating rooms. The germicidal lamp produces ultraviolet rays, which destroy many bacteria and viruses. It has been reported that use of germicidal lamps has decreased the outbreaks of measles in certain schools. Germicidal lamps should be installed and used only under the direction of experts, however, since air currents and reflecting surfaces in the room affect the results.

MARCEL SCHEIN

See also **GERMICIDE**; **ULTRAVIOLET RAYS**.

GERMICIDE is any substance or form of energy which destroys bacteria and certain fungi. It is sometimes called a *bactericide* or *fungicide*. A germicide which destroys the bacteria that cause infection or disease is called a *disinfectant*. Many germicides destroy bacteria by chemical reaction such as oxidation or coagulation. Germicides of this kind are potassium permanganate, chlorine, iodine, ozone, carbolic acid, and mercury. Other germicides such as soaps and creolin destroy bacteria by an emulsifying action.

W. W. BAUER

See also **ANTISEPTIC**; **DISINFECTANT**; **GERMICIDAL LAMP**; **PENICILLIN**.

GERMINATION, *JUR mih NAY shun*, is the natural process in which a seed germ sprouts and begins to grow into a plant. *Germination* is often used to mean the same thing as *sprouting*. The *germ*, *kernel*, or *embryo*, looks like a miniature plant inside the seed. In many cases it has a fairly definite set of organs. There may be a short, rootlike part which later grows into a root. Above this there is often a stem, called the *hypocotyl*, and still higher one or two *cotyledons*, which are seed leaves, and a *plumule*, which is the bud of a true leaf.

Three conditions generally necessary for a seed to sprout are *warmth*, *moisture*, and a supply of *oxygen*. Different plants vary in their temperature requirements. Corn planted too soon will decay in the ground, but peas can safely be sown not long after the soil is free from frost. Moisture softens the outer coat of the seed, and swells the tissues of the embryo. It also helps to dissolve certain food materials in the seed, so they can be used for growth. Too little or too much moisture is equally harmful. Too little retards germination, and too much causes many species to decay. A supply of oxygen is necessary, because, without it, certain chemical changes which accompany growth cannot take place.

The bean is a good example of plants which have two seed leaves (cotyledons). First, the outer coat of the seed, or *testa*, splits open, and a root part, or *radicle*, pushes its way downward into the soil. Soon it grows a covering of fine root hairs. Meanwhile, the cotyledons separate, and as they rise from the ground, a green shoot unfolds between them. At the same time, branches from the root develop in the soil. Under the action of the sunlight, the cotyledons turn green, but, as the plant uses up nourishment stored in them, they wither and fall. A pair of true leaves takes their place.

The pea germinates differently, for its cotyledons remain in the ground while their nourishment is being absorbed. The first leaf that appears above ground is a true leaf. Seeds with only one cotyledon germinate the same way as the pea.

STEPHEN CULVER WILLIAMS

See also **COTYLEDON**; **SEED**.

GERMISTON (pop. 114,215; met. area 166,310; alt. 5,478 ft.), the sixth largest city in South Africa, lies in the heart of the great gold fields of Transvaal Province. For location, see **SOUTH AFRICA** (color map). Germiston is an important airline and railroad center, and has the world's largest gold refinery. Manufactures include explosives, cement, chemicals, machinery, and food products. A large thermoelectric generating plant lies at nearby Germiston Lake.

HIBBERD V. B. KLINE, JR.

GERONIMO, *Juh RAHN uh moh* (1829-1909), was chief of the southern Chiricahua band of Apache Indians. Cochise was chief of the central band (see **COCHISE**). Geronimo's group raided and plundered Mexican settlements for many years. But in 1876, when the United States government put the Apaches on the White Mountain reservation in Arizona, Geronimo led his followers over the border into Mexico. He found camps for his followers in the Sierra Madre Mountains. The camps were cleverly hidden so they could not be attacked.

From this safe base, Geronimo led his warriors on raids into the United States, terrorizing the country

The Apache Chieftain Geronimo in 1886 led one of the last great Indian uprisings against the United States government.

Culver



around Tucson, Ariz. For more than 10 years, he fought a cruel hit-and-run war with the Americans. Once, in March, 1886, he surrendered. But he escaped with his band two days later. Apache scouts serving in the United States Army under General Nelson A. Miles finally captured Geronimo and his band in September, 1886 (see MILES, NELSON APPLETON).

The entire band, including women and children, was sent first to Fort Pickens at Pensacola, Fla. Later they were transferred to Mount Vernon, Ala., and from there to Fort Sill, Okla. Although Geronimo tried several times to escape and to persuade the government to return him to Arizona, he spent the remainder of his life at Fort Sill. He was converted to Christianity, and, in 1903, joined the Dutch Reformed Church. His followers who were still living in 1913 were set free. A few stayed in Oklahoma, but the rest chose to settle on the Mes-calero Apache reservation in southern New Mexico.

Geronimo was born in southern Arizona. His Indian name was *Goyathlay*, meaning *one who yawns*. The Mexicans gave him the name *Geronimo*, which is Spanish for *Jerome*. He was not an hereditary chief like Cochise. Geronimo rose to leadership from the ranks of the people.

E. ADAMSON HOEBEL

See also APACHE INDIANS; INDIAN WARS (Apache Warfare).

GERONTOLOGY. See GERIATRICS.

GERRY, GEHR *ih*, **ELBRIDGE** (1744-1814), was Vice-President of the United States under President James Madison in 1813 and 1814. He also was a signer of the Declaration of Independence, a member of the Continental Congress, and a delegate to the Federal Convention of 1787. He represented Massachusetts in the House of Representatives for four years. In 1797, he went to France to establish diplomatic relations with that country (see XYZ AFFAIR). Gerry served as governor of Massachusetts from 1810 to 1812 (see GERRYMANDER).

He was born at Marblehead, Mass., and was graduated from Harvard in 1762. He then joined his family's business. In 1772, he was elected to the Massachusetts general court.

KENNETH R. ROSSMAN

Elbridge Gerry
Chicago Historical Society



GERRYMANDER, GEHR *ih MAN dur*, is the practice of dividing a city, state, or country into voting districts in an unfair way. The gerrymander is generally used by a party in power as a way of keeping its power.

The word *gerrymander* comes from the name of Governor Elbridge Gerry of Massachusetts (see GERRY, ELBRIDGE). A bill passed by the Massachusetts state legislature in 1812 divided the state into districts for the election of state senators. This division grouped together certain counties which had large Federalist majorities. In this way, the Federalists could win only a few seats in Congress by huge majorities, while their opponents could win many more seats by small majorities.

One of the new districts had a shape much like that of a mythical animal. Some persons said it looked like a salamander, but a guest at a dinner party suggested



Gerrymander was a word which came into use in 1812 when Massachusetts was divided into election districts to defeat the Federalist party. One of the districts shown above had such a queer shape that some of the people said it looked like a salamander. It was finally called a *gerrymander* after Elbridge Gerry, then governor of the state of Massachusetts.

that it should be called a *gerrymander*. The word became popular with Federalists because it expressed their contempt for the governor and the Democratic legislature. Later it became part of the American language. Gerrymandering is still often practiced, although some state constitutions forbid it.

See also HOUSE OF REPRESENTATIVES (Apportionment).

GERSHWIN, GEORGE (1898-1937), an American composer, wrote great musical works based on the rhythms, melodies, and moods of American popular music. His largest, and perhaps greatest, work is the folk opera *Porgy and Bess* (1935), which shows scenes of Negro life near Charleston, S.C. It was the first American opera to triumph in other countries as well as in the United States.

Gershwin's first major composition based on American popular music was *Rhapsody in Blue*. Paul Whiteman's orchestra performed it in 1924 with Gershwin as solo pianist. In 1925, Gershwin finished *Concerto in F* for piano and orchestra. The music of one of his best-known scores, the symphonic poem *An American in Paris* (1928), later was used for a successful motion picture of the same name. His other orchestral and piano works include *Three Piano Preludes* (1926), *Second Rhapsody* for piano and orchestra (1932), and *Cuban Overture* (1934).

Gershwin also wrote musical comedies, including *La, La, Lucille* (1920),

George Gershwin
Courtesy of John Hancock
Mutual Life Insurance Co.



GERSOPPA, FALLS OF

Lady Be Good (1924), *Tip Toes* (1925), *Oh, Kay* (1926), *Funny Face* (1927), *Strike Up the Band* (1929), *Girl Crazy* (1930), and *Of Thee I Sing*, which won the Pulitzer prize in drama in 1932. Some of his best-known songs are "Swanee," "The Man I Love," "I Got Rhythm," and "Summertime."

Gershwin was born on Sept. 26, 1898, in Brooklyn, N.Y. Although he studied with excellent music teachers, he first aimed for popular success rather than artistic fame.

GILBERT CHASE

GERSOPPA, *jur SAHP uh*, **FALLS OF**, is an 830-foot waterfall on the Sharavati River, in the state of Mysore, India. The waters rush down in four separate streams. The Falls of Gersoppa are known for their great beauty. They are located in the mountain range along the west coast of peninsular India, a region called the Western Ghats.

LOYAL DURAND, JR.

See also **WATERFALL** (color picture).

GERUND. See **PARTICIPLE**.

GERYON. See **HERCULES** (The Twelve Labors).

GESELL, *guh ZEHL*, **ARNOLD LUCIUS** (1880-1961), an American psychologist, became known for his studies of the behavior of infants and children. He found that the growing child's behavior seemed to follow a set developmental pattern, and made a major contribution in detecting and describing characteristic features of children's behavior at different ages. The results of his work are widely applied in child guidance and parental education. Gesell wrote *Atlas of Infant Behavior* (1934). He was born in Alma, Wis.

GESSLER. See **TELL**, **WILLIAM**.

GESSO, *JESS oh*, is a plasterlike coating used to cover the grain of wooden surfaces. Artists paint these coated surfaces or inlay them with gold or silver leaf. Gesso is made by heating a glue solution to which powdered chalk or whiting has been added. The mixture forms a thin, creamy liquid. While it is still hot, the artist brushes the mixture on wood. He allows it to dry, then polishes it to a smooth, ivorylike finish. Gesso is used chiefly on picture frames, gilded furniture, and wood panels for tempera painting.

RALPH MAYER

GESTALT PSYCHOLOGY. See **PSYCHOLOGY** (Gestaltism and Behaviorism).

GESTAPO, *geh STAH poh*, was the secret police force of Nazi Germany. The name is a short form of *Geheime Staatspolizei*, German for *Secret State Police*. The Nazi party used the Gestapo, noted for its power and brutality, to smash opposition. The Gestapo was created in 1933. It was combined with the regular police force in 1936, and Heinrich Himmler became the head of the whole organization. Gestapo agents were often chosen from members of the Elite Guard, or Storm Troopers. See also **HIMMLER**, **HEINRICH**; **NAZISM**. JOHN J. FLOHERTY

GESTATION, *jess TAY shun*, is the period of pregnancy of all mammals, including man. It is the length of time during which the young animal develops in the mother animal up to the time it is born. The gestation period and the number of young born at one time vary in different animals. In the larger mammals such as the elephant, the period of gestation is long, and the animals usually give birth to one baby at a time. Smaller mammals such as the rabbit have a short gestation period with many young born in a single litter. See also **EMBRYO**; **REPRODUCTION**.

STEPHEN CULVER WILLIAMS

GETA. See **JAPAN** (Ways of Life).

GETHESEMANE, *geth SEM uh nee*, is a beautiful garden of olive trees, spoken of in the New Testament. The word *gethsemane* means *oil press*. The garden was located just east of Jerusalem, above the brook Kidron, on the side of the Mount of Olives (see **MOUNT OF OLIVES**). Jesus went there often to meditate and pray.

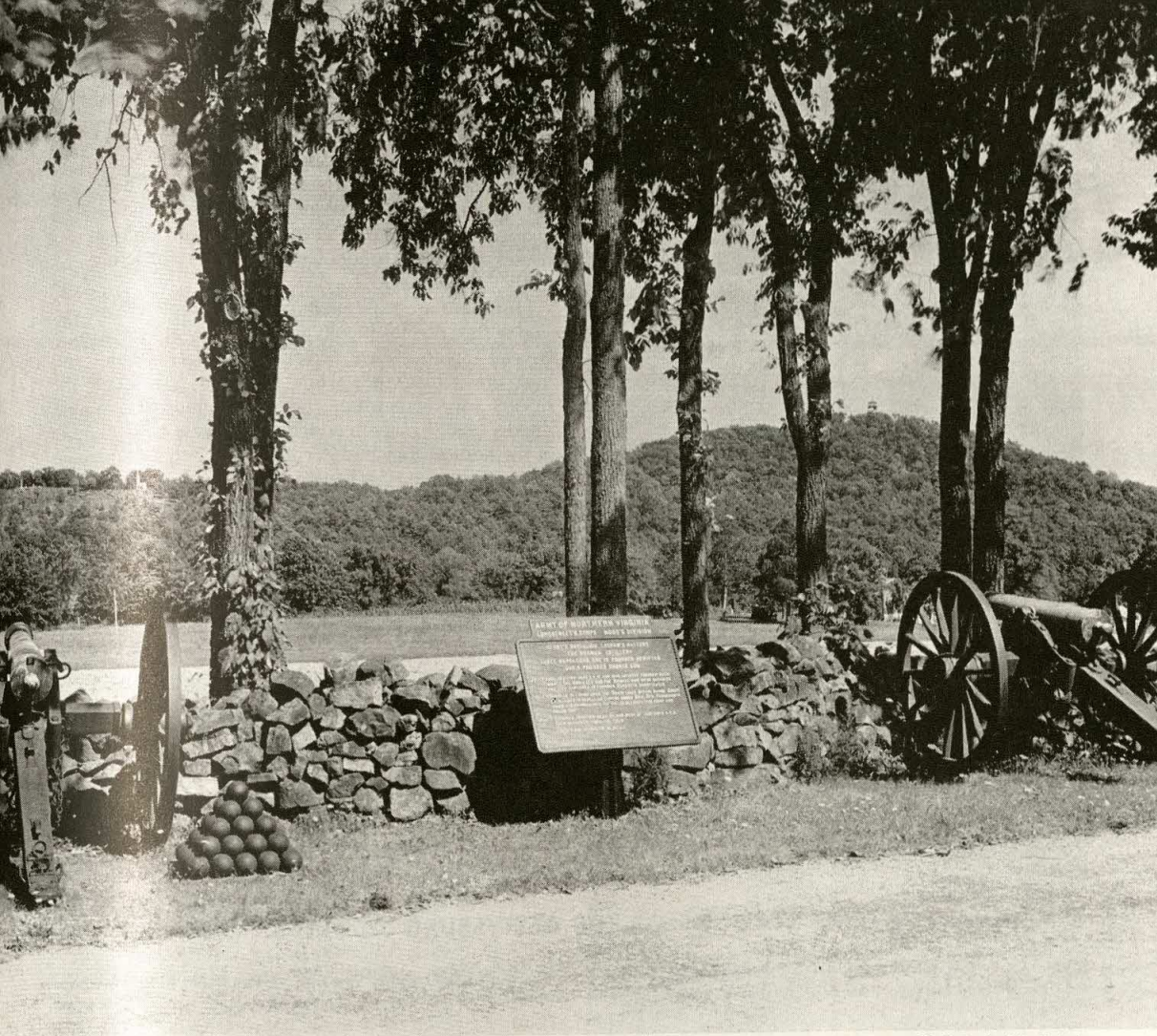
The exact location of the garden is not now known. The Latins built a wall around a plot of ground just across the Kidron from Jerusalem. They arranged it as a European garden, and kept it as a sacred spot, "the Garden." The Greeks, however, thought that Gethsemane was a little to the southeast of this garden. A third possible location was thought to be a short way north of both these places, beside the Virgin's tomb. There is a cave to the right of the Church of the Tomb of the Virgin, called "the Grotto of the Agony." Friars of the Franciscan order have controlled the Grotto since 1392, and the Garden since 1681.

There are eight large olive trees in the Garden, at least 1,300 years old. The Jewish historian Josephus tells us that all the trees near Jerusalem were cut down by the Romans at the time they besieged the city from A.D. 68 through 70. **FREDERICK C. GRANT** and **FULTON J. SHEEN**

De Cou, Ewing Galloway



The Garden of Gethsemane. A Franciscan Church rises in the background. It was to this garden, just outside the "Golden Gate" of Jerusalem, that Jesus went with His disciples. Here He prayed while they slept. It was here, too, that Judas betrayed Him with a kiss.



U. S. Dept. of the Interior

Gettysburg National Military Park, Gettysburg, Pa., was the scene of a great Civil War battle in July, 1863. The

marker, foreground, shows the position of a Confederate battery. Round Top Hill, right, was at the southern end of the Union lines.

GETTYSBURG, Pa. (pop. 7,960; alt. 520 ft.), is the site of one of the most famous battles in United States history. On July 1, 1863, the Confederate Army under General Robert E. Lee met the Union Army under General George G. Meade there in what experts consider a turning point of the Civil War. After a three-day battle, Lee's army retreated. President Abraham Lincoln delivered his famous Gettysburg Address there on Nov. 19, 1863 (see **GETTYSBURG ADDRESS**). The battlefield has been made into a national military park. See **NATIONAL PARK** (National Military Parks).

Gettysburg lies about 35 miles southwest of Harrisburg, the state capital. For location, see **PENNSYLVANIA** (color map). Farmer James Gettys founded it in about 1790. Gettysburg serves as the seat of Adams County, and has a mayor-council form of government. It is the home of Gettysburg College and the Lutheran Theological Seminary. The farm of former President Dwight D. Eisenhower lies near Gettysburg. S. K. STEVENS

GETTYSBURG, BATTLE OF, fought from July 1 through July 3, 1863, marked a turning point in the

Civil War. General George G. Meade led a Northern army of about 90,000 men to victory against General Robert E. Lee's Southern army of about 75,000. The two forces met accidentally in the little town of Gettysburg, Pa. The shooting began when a Confederate brigade ran into Union cavalry in Gettysburg on July 1.

The two armies spent the first day maneuvering for position. Northern troops settled south of town in a strong defensive position. Lee tried to crack the left side of the Union's defenses on the second day. The attack crushed a Northern corps, but failed to occupy the position. On July 3, Lee decided to aim directly at the Union center. In a famous charge, General George E. Pickett's troops advanced across an open field and up the slopes of Cemetery Ridge into murderous Northern fire. They reached the crest of the ridge, but could not hold the position. Lee withdrew his battered army to Virginia. His forces suffered more than 20,000 casualties. Meade had about 18,000 casualties.

See also **CIVIL WAR** (Gettysburg; table, Major Battles; color picture, One of the Greatest Battles).



© Gerlach-Barklow Co.

Abraham Lincoln Delivered the Gettysburg Address
four months after the historic Civil War battle was fought.

GETTYSBURG ADDRESS is a short speech that Abraham Lincoln delivered on Nov. 19, 1863, at the site of the Battle of Gettysburg in Pennsylvania. He delivered the address at ceremonies to dedicate a part of the battlefield as a cemetery for those who had lost their lives in this Civil War battle. Lincoln chose his simple, noble words with such care that, ever since that day, they have stirred the deepest feelings of Americans.

★ ★ ★ TWO VERSIONS OF THE GETTYSBURG ADDRESS ★ ★ ★

Lincoln wrote five different versions of his famous Gettysburg Address. He held the second version, *left below*, in his hand while

Lincoln made five handwritten copies of the speech. He wrote most of the first version in Washington, before traveling to Gettysburg. At Gettysburg, he probably revised the first version, and then made a second. Lincoln planned to read the second version, and he held it in his hand while speaking. But he made several changes as he spoke. The most important change was to add the phrase "under God" after the word "nation" in the last sentence.

Historians are reasonably sure they know which version of the speech Lincoln actually gave at Gettysburg. Several reporters were present at the ceremonies and took down his words while he spoke. Although the reports vary somewhat, they all include the phrase "under God." Lincoln added that phrase to the copies of the address that he later made after the ceremonies at the Gettysburg battlefield.

Lincoln made the last copy of the address in 1864. This was the only copy he signed. This fifth version is the one carved on a stone plaque in the Lincoln Memorial.

Many false stories have grown up about this famous speech. One story says that the President wrote it in pencil on the back of an old brown envelope while on the train going to Gettysburg. According to another story, the people of Lincoln's time did not appreciate his speech. But Edward Everett, the principal speaker at the dedication, wrote to Lincoln: "I should be glad if I could flatter myself that I came as near to the central idea of the occasion in two hours as you did in two minutes." Many newspapers also immediately recognized the inspired nobility of the President's brief remarks.

PAUL M. ANGLE

he spoke at Gettysburg. The fifth version, *right below*, perhaps represents as exactly as can be known the speech he gave.

Four score and seven years ago our fathers brought forth, upon this continent, a new nation, conceived in Liberty, and dedicated to the proposition that all men are created equal.

Now we are engaged in a great civil war, testing whether that nation, or any nation, so conceived, and so dedicated, can long endure. We are met here on a great battle-field of that war. We have come to dedicate a portion of it as a final resting place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this.

But in a larger sense we can not dedicate—we can not consecrate—we can not hallow this ground. The brave men, living and dead, who struggled here, have consecrated it far above our poor power to add or detract. The world will little note, nor long remember, what we say here, but can never forget what they did here. It is for us, the living, rather to be dedicated here to the unfinished work which they have, thus far, so nobly carried on. It is rather for us to be here dedicated to the great task remaining before us—that from these honored dead we take increased devotion to that cause for which they here gave the last full measure of devotion—that we here highly resolve that these dead shall not have died in vain; that this nation shall have a new birth of freedom; and that this government of the people, by the people, for the people, shall not perish from the earth.

Four score and seven years ago our fathers brought forth on this continent, a new nation, conceived in Liberty, and dedicated to the proposition that all men are created equal.

Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated, can long endure. We are met on a great battle-field of that war. We have come to dedicate a portion of that field, as a final resting place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this.

But, in a larger sense, we can not dedicate—we can not consecrate—we can not hallow—this ground. The brave men, living and dead, who struggled here, have consecrated it, far above our poor power to add or detract. The world will little note, nor long remember what we say here, but it can never forget what they did here. It is for us the living, rather, to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us—that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion—that we here highly resolve that these dead shall not have died in vain—that this nation, under God, shall have a new birth of freedom—and that government of the people, by the people, for the people, shall not perish from the earth.

GETTYSBURG COLLEGE is a coeducational liberal arts and sciences school at Gettysburg, Pa. It is the oldest Lutheran college in America, and was the first independent college to have an ROTC unit (1916). The school was founded in 1832 as the Pennsylvania College of Gettysburg. The name was changed to Gettysburg College in 1921. For enrollment, see UNIVERSITIES AND COLLEGES (table).

F. HOFFMAN

GETTYSBURG NATIONAL MILITARY PARK. See NATIONAL PARK (National Military Parks); PENNSYLVANIA (color picture).

GEYSER, *GY zer*, is a spring that throws up hot water with explosive force from time to time. Often the water shoots up from a geyser in great columns, cloudy with steam. Geysers are famous tourist attractions in several countries, and people often travel long distances to see them.

"Old Faithful" in Yellowstone National Park is probably the world's most famous geyser. On the average it erupts for about 4 minutes once in every 65 minutes. On two occasions its eruptions were only 33 minutes apart, and once it waited 91 minutes. But the average of about 65 minutes is fairly dependable. The height of the eruptions is usually from 120 to 150 feet. Men have observed "Old Faithful" for more than 80 years, and it has never missed an eruption during that time.

Most other geysers erupt at irregular intervals, and no one knows when they will go off. Some geysers erupt several times in an hour. Others do not go off for hours, days, weeks, or even months. In some the water only bubbles a few feet above the ground. In others it soars in fountains over 100 feet high.

Where Geysers Are Found. There are at least 200 active geysers in Yellowstone Park. One, known as the "Giant," throws a column of water 175 feet into the air. Two other noted geyser groups are found in lands extremely different from each other. One lies in Iceland, "the land of frost and fire," 70 miles from Reykjavík, the capital, in the midst of barren lava fields. Here dozens of geysers appear within a circle of 10 miles. The other group of geysers is located far to the south and on the other side of the world, in New Zealand, a country green with plant life.

How Geysers Are Formed. Geysers are formed near rivers and lakes, where water drains through the earth deep below the surface. A deep channel reaches from the surface far into the earth. Cold water seeps down this channel until it reaches rocks that are very hot. Then it fills the channel. The water at the bottom is heated by the rocks. But the water cannot boil because of the weight of the column of water above it. Gradually the heat at the bottom of the column rises far above the boiling point for water. Steam begins to form. The rising bubbles lift the water column a little, pushing some of the water in the channel over the opening onto the surface of the earth. That makes the column of water lighter, and more water is able to turn into steam. This in turn lifts the column still more, until suddenly all the water near the bottom of the channel expands into steam and forces out the rest in a steam explosion. After the water and steam settle back on the earth, some of the water seeps back into the earth and fills up the channel again.

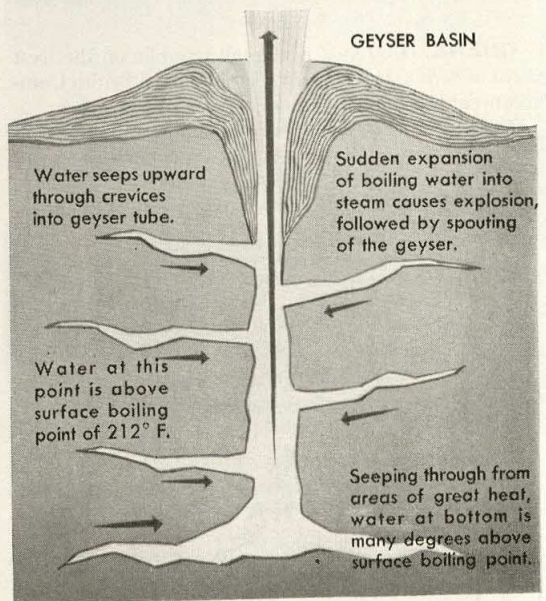
Geysers have often been compared with volcanoes, for they act in much the same way. But volcanoes shoot



U. S. Geological Survey

HOW GEYSERS ERUPT

The Lone Star Geyser in Yellowstone National Park shoots water 25 feet into the air.



forth melted rock, while geysers erupt water that contains mineral matter in solution. After the eruption the water evaporates or seeps back into the earth, leaving deposits of silica or lime carbonate. These deposits often take beautiful and curious forms. Many of them form cones. Some, like the "Giantess" in Yellowstone Park, form craters which fill with wonderfully clear water between eruptions. Very little water is left after the eruption of a geyser which has a cone. One exception is the tiny "Model" in Yellowstone Park. All the water falls back into its cuplike cone. The mineral deposits of some geysers form into weird castlelike shapes and towers.

ERNEST E. WAHLSTROM

See also ICELAND (Location, Size, and Surface Features); SILICA; VOLCANO; YELLOWSTONE NATIONAL PARK.



Wide World

GHANA

Tribal Chieftains attended the ceremonies opening Ghana's first parliament.

The Library at Accra is one of Ghana's finest buildings.



GHANA, *GAH nuh*, is a small republic on the west coast of Africa. It is the first member of the British Commonwealth of Nations to be governed by Negroes.

The Land and Its Resources. Ghana has a population of 4,118,450 and covers 91,843 square miles. Ivory Coast, Togo, and Upper Volta border the country. Its coast runs about 340 miles along the Gulf of Guinea.

The Volta River system drains most of Ghana. Dense forests cover large areas, and rich mineral deposits include bauxite, diamonds, gold, and manganese. Annual temperatures average 80°F. About 40 to 60 inches of rain falls each year in most of Ghana.

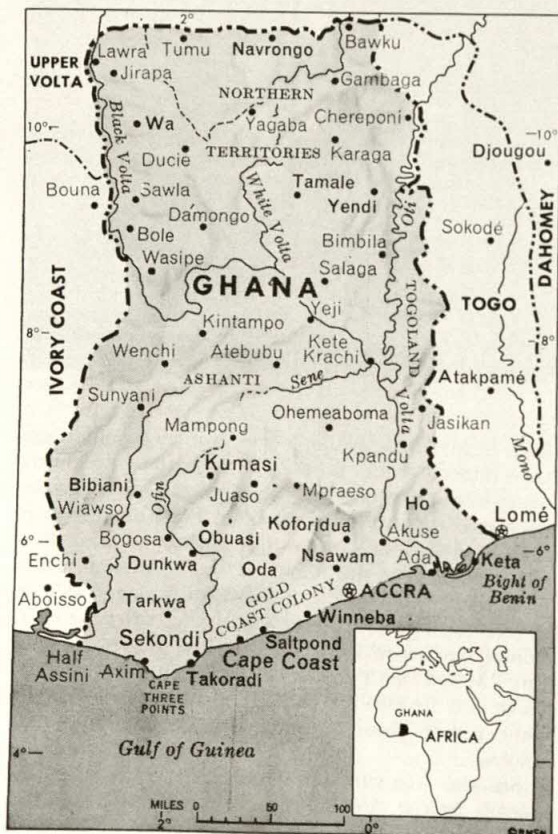
Life of the People. Ghana's main crops are cocoa, coffee, tobacco, and spices. Farmers raise cattle, goats, pigs, and other livestock. Exports include cocoa, copra, diamonds, hides, mahogany, palm oil, and rubber. About 550 miles of railroads and more than 7,000 miles of roads and highways provide transportation in Ghana. Accra has international air service. Ghana has two universities, University College at Achimota and Kumasi College of Technology at Kumasi.

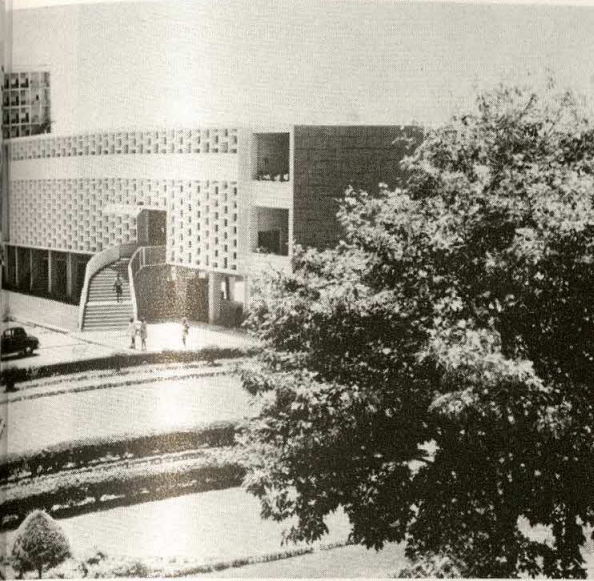
Cities. Accra (pop. 135,926) is the capital and chief city of Ghana. Other cities, together with their populations, include Kumasi (59,420), Sekondi (26,757), Cape Coast (23,346), Koforidua (17,806), Takoradi (17,800), Tamale (16,164), Obuasi (15,876), Winneba (15,171), and Keta (11,380).

History. In ancient times, an empire called Ghana covered the territory of present-day Ghana and much of the surrounding country. The empire began in about the 300's and reached its height from the 800's to the 1000's. But in the 1100's and 1200's, it suffered military defeats by neighboring kingdoms. In the 1200's, its capital, Kumbi-Kumbi, was destroyed.

Portuguese gold and slave traders founded the first white settlement in what is now Ghana in the 1400's. They named it the Gold Coast because of its rich gold deposits. During the 1600's and 1700's, British, Danish, and Dutch slave traders opened posts along the Gold Coast. Most of the slaves who were brought to America came from the Gold Coast. In 1871, the British made the area a protectorate of Great Britain, and, in 1886, they declared it a colony. In 1896, they added a territory called Ashanti. They added the Northern Territories, north of Ashanti, in 1901.

In 1946, Great Britain granted the colony a new constitution which gave Africans a majority of seats in the





British Information Services

streams and canals. It has more than 200 bridges. Its town hall, built in the 1500's, is considered the finest example of Gothic architecture in Belgium.

The first buildings at Ghent were two monasteries built in the 600's. Ghent became important during the Middle Ages and reached its height in the 1400's. For many years afterward, Ghent was torn by revolutions and war. It was held by the Spanish, French, and Austrians at various times before Belgium became independent. Ghent was occupied by German forces in World Wars I and II.

DANIEL H. THOMAS

See also FLANDERS.

GHENT, TREATY OF, ended the War of 1812 between Great Britain and the United States. The two countries signed the treaty at Ghent, Belgium, on Dec. 24, 1814, and then ratified it on Feb. 17, 1815. The American negotiators were John Quincy Adams, James A. Bayard, Henry Clay, Jonathan Russell, and Albert Gallatin. The British representatives were Sir James

legislature. After riots broke out in 1948 and 1950, Britain granted more freedom. The colony received independence within the British Commonwealth in 1957, and the British protectorate of Togoland joined the new nation. The people elected Kwame Nkrumah, prime minister of the colony since 1952, the first prime minister of the new nation. They also elected 104 members to a one-house legislature, the National Assembly. The country again called itself Ghana.

On July 1, 1960, the legislature voted to make Ghana a republic within the British Commonwealth. As a republic, the country ceased to recognize Elizabeth II of Great Britain as its queen. Nkrumah became the country's first president. On Aug. 28, 1960, Ghana signed trade agreements with Russia.

ALAN P. MERRIAM

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Chocolate	Manganese	Togo and Togoland
Cocoa	Money (table)	Voting (picture)
Gold	Nkrumah, Kwame	

GHATS, *gawtz*, are two low mountain ranges that border the Peninsula of India on the west and on the east. The *Western Ghats* form a nearly continuous chain from the Tapi River on the north to Cape Comorin at the southern tip of the peninsula. Peaks in this range rise from 4,000 feet to more than 8,000 feet. The *Eastern Ghats* are a disconnected line of hills that mark the edge of the lowland east of the Mysore, Hyderabad, and Orissa uplands. Most of the peaks in this range are less than 3,000 feet high.

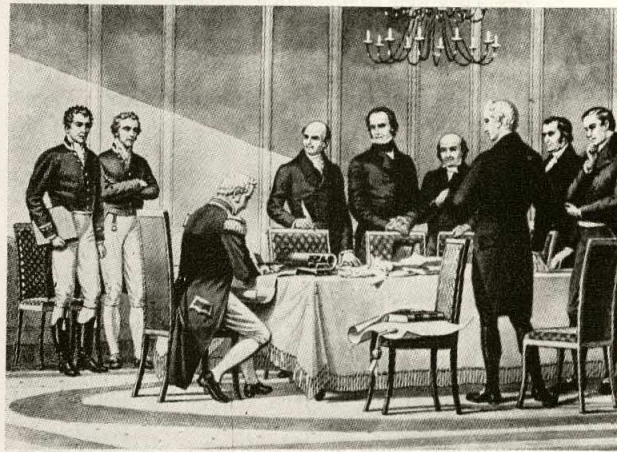
J. E. SPENCER

GHAZI, KING. See IRAQ (Independence).

GHEBERS. See ZOROASTRIANS.

GHENT, *gent*, or **GENT** (pop. 161,382; met. area, 325,000; alt. 33 ft.), called *Gand* in French, is a Belgian city 31 miles northwest of Brussels. It lies at the fork of the Schelde and Lys rivers, and is second only to Antwerp as a Belgian seaport. A ship canal built in 1886 connects the city with the North Sea. Ghent is famous for its flax and cotton mills.

Like many Belgian cities, Ghent is crisscrossed by



Brown Bros.

The Treaty of Ghent, signed on Dec. 24, 1814, ended the War of 1812. The American peacemakers were John Quincy Adams, James A. Bayard, Henry Clay, Jonathan Russell, and Albert Gallatin.

Gambier, Henry Goulburn, and William Adams. The treaty settled none of the disputes that caused the war. It merely restored the situation that had existed before the war. The treaty did not even mention the fact that American seamen had been forced to serve on British ships. This omission was less important than it seemed, because the British had no reason to continue the practice after the final defeat of Napoleon in 1815.

The Treaty of Ghent marked the beginning of a period in which Great Britain and the United States chose to settle their disputes peacefully. The troublesome fisheries question, the problem of payment for slaves seized by the British during the war, and the disagreement over the northwestern boundary were all worked out in later negotiations. The Rush-Bagot agreement of 1817 provided for naval disarmament on the Great Lakes, and paved the way for an unfortified frontier between Canada and the United States.

JOHN D. HICKS

See also WAR OF 1812 (Treaty of Ghent).

GHERKIN. See CUCUMBER; PICKLE.

GHETTO

GHETTO, *GET oh*. After the Romans conquered Palestine in A.D. 70, many Jews left Palestine to settle in all parts of Europe. Separate Jewish communities, or *ghettos*, arose in almost all European cities. Later, Jews were often forced to live in separate sections of cities. In recent times, Jews usually have not been compelled to live in ghettos, but some have preferred to live in them. In the United States, the name *ghetto* has been popularly applied to the section of a large city where recent Jewish immigrants of modest income live by their own choice. More recently the term also has been given to settlements of any distinct racial or national group, such as Negroes, Mexicans, Japanese, Poles, or Italians. The origin of the word *ghetto* is uncertain, but it may have been first used in Italian cities.

The Early Ghettos. In the Apostle Paul's *Epistle to the Romans*, he promises to visit the Jewish communities in Spain, and so we know that there were scattered Jewish settlements outside Palestine in Biblical times. It was natural at first for the Jews to form separate communities. They were strangers in a strange land. They had a different religion and way of life. They found it easier to hold their traditions, use their own language, and practice their own rituals if they lived apart.

But soon the Jews were forced to live apart. As early as the 300's, the Christian Church issued decrees forbidding Christians to live on terms of intimacy with Jews. During the Dark Ages the Jews in all western lands led an uncertain life. Persecution of the Jews became increasingly violent during the Crusades, beginning in 1096. They were looked upon as infidels, and were sometimes chased from their homes and killed.

The ghettos of the Middle Ages were generally undesirable sections of the towns. They were densely crowded. Often they were surrounded by walls with gates which were locked at night and on Christian holidays. Movement of Jews outside the ghettos was limited.

The compulsory ghetto died out as a result of the intellectual and social movements of the Renaissance and the industrial revolution. After the French revolution, the Jews regained their freedom and civil rights in a number of countries. But the ghettos were revived by the Nazis in Germany and by the Fascists in Italy after 1933. In many parts of Europe under Nazi control, ghettos were re-introduced and remained until the end of World War II. Millions of Jews were persecuted. The Soviet Union also has discriminated against Jews.

The Modern Ghetto. The tearing down of ghetto walls and the acquisition of legal freedom by the Jews did not bring an end to the ghetto. Jewish communities continued a more or less separate existence in all large modern cities. But as political, economic, and educational opportunities spread, and as contact with other peoples increases, the ghetto tends to blend with the larger community, and finally disappear.

Such Jewish communities as parts of New York City's Lower East Side and Chicago's near West Side became distinctive sections much like the ghettos of Europe. But immigration from Europe decreased, and younger Americanized Jews left these areas.

LOUIS WIRTH

See also **Jews** (Persecution of the Jews).

GHIBELLINES. See **GUELPHS** AND **GHIBELLINES**.



Allmari

Christ Walking on the Water, by Lorenzo Ghiberti, is one of the bronze panels Ghiberti cast for the north doors of the baptistery of Florence. He also designed the east doors.

GHIBERTI, *gee BEHR tee*, **LORENZO** (1378-1455), was an Italian sculptor and goldsmith during the Renaissance. He made some of the bronze doors for the baptistery, a building used for baptisms, in Florence. He worked 21 years on the eastern doors, and made 28 panels representing scenes from the New Testament and figures of saints. These doors were so successful that Ghiberti received the commission for a second pair on the north side of the baptistery. It took him even longer to complete these doors (see **Door** [picture]).

Ghiberti's autobiography states that he completed many other projects while working on the baptistery doors. His statue, *Saint John*, at Or San Michele in Florence, is generally considered his greatest work. His other great statues were of Saint Matthew and Saint Stephen. Ghiberti's contemporaries wrote that some of his best work was his goldsmithing, but none of it exists today. He was born in Florence, and spent most of his life there.

MARVIN C. ROSS

GHIRLANDAJO, or **GHIRLANDAIO**, *gear lahn DAH yoh*, **DOMENICO** (1449-1494), was the most successful Italian painter of his time in Florence. He painted several large frescoes which are traditional and routine in composition and expression. But in portraits in the frescoes and in separate small paintings, he produced vivid representations of the personalities of Lorenzo the Magnificent's age (see **MEDICI**).

Michelangelo was one of his apprentices. Ghirlandajo was born in Florence.

CREIGHTON GILBERT

GHOST is believed by some people to be the unhappy and often harmful spirit of a dead person. Once, many superstitious people believed in ghosts. As more persons became educated, the belief in ghosts declined. However, belief in ghosts still persists in parts of the world.

There are many different ideas about the powers of a ghost. Some people insist that a ghost can be heard but

never seen. Others believe that ghosts are visible to some people and can be recognized because they never cast shadows or leave footprints, and can walk through closed doors and solid walls.

Believers in ghosts think that some evil causes ghosts on earth. They say that the ghost exists to right a wrong or revenge a crime. For example, they think that the spirit of someone who was murdered will return and cause trouble for the killer. This association with crime causes many to fear the possibility of ghosts.

Ghosts are supposed to work only at night when light is poor. A person's senses can play tricks on him when it is difficult to see. A fluttering rag, reflected moonlight, or a white stone, may have led superstitious people to believe that they had seen a ghost. Animal movements, shutters slamming in the wind, or creaking doors also lead people to believe in ghosts.

Ghosts play a part in many primitive religions. They have always been a favorite subject of writers and storytellers. Shakespeare created several famous ones in his tragedies, particularly in *Hamlet* and *Macbeth*. Marley's ghost in Dickens' *A Christmas Carol* is a well-known literary figure.

JOHN MULHOLLAND

See also ANIMISM; MAGIC; SPIRITUALISTS; VAMPIRE.

GHOST TOWN. In the 1800's, many towns grew up near mines in the western part of the United States. When the mines were worked out, the towns were abandoned. Their ruins now are called *ghost towns*. See also IDAHO (Interesting Places to Visit); NEVADA (Interesting Places to Visit); WESTERN FRONTIER LIFE (Frontier Towns).

GHOST WRITER provides speeches, articles, or books for a famous person. He often writes an "autobiography" for someone who could not write it himself.

A Graceful Angel shows the delicate detail Domenico Ghirlandajo included in his paintings. The angel appears on an altarpiece which is now in the Uffizi Gallery in Florence.



GIANNINI, AMADEO PETER

GI is a common term for men in the United States Army. It was first applied to the men in the ranks of the U.S. Army during World War II and the Korean War. *GI* is an abbreviation for *general issue*, a term for clothing or equipment issued to men in the U.S. Army.

GI BILL OF RIGHTS is the popular name for two programs of benefits to help veterans of World War II and the Korean War adjust to civilian life. The first GI Bill was the Servicemen's Readjustment Act of 1944 for World War II veterans. In 1952, Congress passed the second GI Bill, the Veterans' Readjustment Assistance Act, for Korean War veterans. The main benefits of the two programs included education and training at government expense, unemployment allowances, and government-guaranteed loans for homes, farms, and businesses. The Veterans Administration (VA), a federal agency, handles the education and loan programs. The states administer the unemployment allowances through the Department of Labor.

Nearly 8,000,000 veterans, or half of those who served in World War II, trained under the first GI Bill. Of this number, 2,200,000 attended college. The remainder trained in schools below college level, on the job, or on the farm. Almost all educational benefits under the first GI Bill ended in 1956. More than 2,314,000 Korean War veterans, or 2 of every 5 who served, trained under the second GI Bill. Half of them enrolled in colleges or universities.

Under the loan program, 5,735,000 veterans of World War II and the Korean War have obtained loans having a total value of over \$48,000,000,000. Most loans were for buying homes, the others for farms or businesses. Less than 1 of every 100 veterans making loans defaulted to the point where the VA had to make good its guarantee. World War II veterans had until July, 1960, to apply for loans.

SUMNER G. WHITTIER

See also BONUS; VETERANS ADMINISTRATION.

GIACOMETTI, JAH koh MET ih, ALBERTO (1901-), is an Italian sculptor. His highly unusual and individual style, characterized by the extreme elongation and thinness of his figures, failed to attract much attention until after World War II. Since then, however, his terra-cotta and bronze sculptures have received praise for their unique interpretation of proportions and space. In *Persons Traversing a Square* (1949), wirelike figures of rough texture move across a flat marble base. Giacometti was born in Switzerland.

WILLIAM MAGDONALD

GIANNINI, jahn NEE nee, AMADEO PETER (1870-1949), an American businessman, founded the Bank of America, the world's largest commercial bank. In 1904, he founded the Bank of Italy in San Francisco. He bought many other banks, and formed a huge branch banking system. The Bank of Italy became the Bank of America in 1930. Giannini was born in San Jose, Calif., on May 6, 1870. See also BANK OF AMERICA. DONALD L. KEMMERER

Amadeo Peter Giannini
Bank of America



GIANTS



Ewing Galloway

← **The Long and Short of It.** The circus cowboy stands 8 feet 7 inches in his stocking feet. His midget friend stands only about 2 feet tall.

→ **Jack the Giant Killer** is carried off by the giant Blunderbore. This is an illustration by Florian for *Wonder Tales of Giants and Dwarfs*, adapted by Janet Murtaugh.



© 1945 by Domesday Press

GIANT, *JI unt*, is a human being or animal that is very much larger in size than normal. A human giant may grow more than 9 feet tall. This condition is known as *gigantism*. It is caused by great increase in the rate of growth, not in the length of the growing period.

Gigantism results when the anterior lobe of the pituitary gland is overactive. This ductless gland produces several substances called *hormones*, which have a great effect on growth. If this gland becomes overactive in adults who are fully grown, gigantism may occur only in certain parts of the body. A condition in which parts of the body, and not the body as a whole, become enlarged is called *acromegaly*. The bones of the face, particularly the chin, and the hands and feet often become very large and noticeable. Gigantism should be treated in its earliest stages. The child or adult who shows such symptoms should be under constant care of a physician who has much experience in the treatment of glandular disturbances.

G. W. BEADLE

See also **PITUITARY GLAND**.

GIANT, in Greek and Roman mythology, belonged to a race of beings that looked like men, but were much larger in size. It was the belief of the ancient Greeks and Romans that men had grown smaller as time went by. They thought that their forefathers had been huge men of great strength and power.

Giants, in Greek legend, represented the elements of nature, such as earth, air, and water. They were said to have been born from the blood of Uranus (Heaven) which fell into the lap of Gaea (Earth). The Greek giants were called Titans (see **TITAN**).

Giants appear in the mythology of every country. Welsh giants are well known through the story of Jack the Giant Killer. Paul Bunyan is a giant in folk stories

of the American lumber camps (see **BUNYAN**, PAUL).

Races of giants are first spoken of in the Bible in Genesis 6:4. One giant, King Og of Bashan, had a bed 9 cubits long. A Hebrew cubit is 17.58 inches, and 9 cubits is over 13 feet. Goliath, who was killed by David with his slingshot, was the best-known giant in the Bible. He was 9½ feet tall.

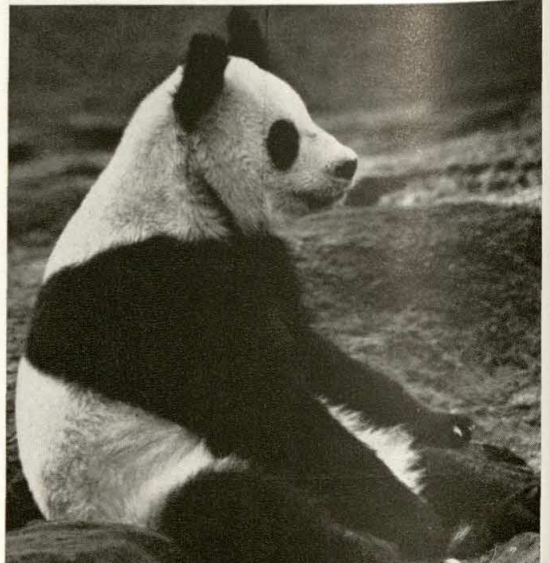
PADRAIC COLUM

GIANT DANIO. See **FISH** (color picture, Tropical Fresh-Water Fishes).

GIANT PANDA is a rare mammal related to the raccoon. It lives in western China and Tibet, and is so difficult to find that only a few have been brought to

The Giant Panda has black ears and black patches around its eyes. Its playful nature makes it a favorite animal at the zoo.

Ylla, Rapho Guillumette



the United States alive. The giant panda has a white, chubby body with black legs and shoulders. Its face looks like that of a bear, and is white with a round, black spot at each eye. It has small, round, black ears. Scientists in Europe considered pandas a myth until the middle 1800's. About 1870, French missionaries in China sent the bones and skin of a giant panda to a Paris museum. See also **ANIMAL** (color picture, Europe and Central Asia); **PANDA**; **RACCOON**.

Scientific Classification. The giant panda belongs to the family *Ailuropodidae*. It is genus *Ailuropoda*, species *melanoleuca*.
HAROLD E. ANTHONY

GIANT SCHNAUZER is the largest dog of the schnauzer family. It has the build of a terrier, but may stand as high as 25 inches. It comes from Bavaria in southern Germany, where it was used to herd cattle. It is an intelligent dog, easily trained for police work or war service. The giant schnauzer has close, hard, wiry hair that gives it an unruly appearance. Its coat usually is pepper-and-salt color, pure black, or black with tan. Stubby whiskers grow on its muzzle and chin. Usually, owners have its ears trimmed and its tail cropped. HENRY P. DAVIS

GIANT SPRINGS. See **MONTANA** (Interesting Places to Visit).

GIANT'S CAUSEWAY is an unusual formation of rock columns along the north coast of County Antrim in Northern Ireland. This natural wonder gets its name from an old legend that the causeway was built by Finn Mac Cool, or Fingal, to bridge the channel from Ireland to Scotland so that giants could pass over it. The causeway is formed of about 40,000 separate columns, quite close together. Some of the pillars are as much as 20 feet in height. They are from 15 to 20 inches in diameter. Groups of them have such names as the Wishing Chair and Lady's Fan. Geologists believe the causeway resulted from the contracting of a lava flow. See also **BASALT**.
ELDRD D. WILSON

GIAUQUE, *see OHK*, **WILLIAM FRANCIS** (1895-), an American chemist, won the 1949 Nobel prize in chemistry for pioneer work in the field of very low temperatures. He was the first to obtain a temperature close to $-273^{\circ}\text{C}.$, absolute zero. From information gained at these low temperatures, he accurately pre-



Evelyn M. Shafer

The Giant Schnauzer, the largest of the schnauzer family, has the build of a terrier and the strength of a working dog.

dicted the existence of two isotopes of oxygen. Giauque was born of American parents at Niagara Falls, Ont., Canada. He studied and taught at the University of California.
HERBERT S. RHINESMITH

GIBBERELIC, *JIB ur EHL ick*, **ACID** is one of several *gibberellins*, which are substances that stimulate the growth of plants. Scientists believe that the gibberellins are natural plant products. These substances make plants grow larger, induce blossoming, and speed up seed germination. They also seem to promote the growth of trees and of agricultural crops.

GIBBON, *GIB un*, is a small ape with long arms and no tail. It is one of the anthropoid, or manlike, apes, which also include gorillas, chimpanzees, and orangutans. The gibbon is the smallest and least manlike of the anthropoids. Many species of gibbon are about 3 feet tall, but some are smaller. See also **ANIMAL** (color picture, India, South Asia, and East Indies). W. M. MANN

GIBBON, EDWARD (1737-1794), a British historian, wrote the *History of the Decline and Fall of the Roman Empire*. This work, published in six large volumes between 1776 and 1788, was immediately hailed as a masterpiece, even by many who disagreed with certain portions. It is still admired both as history and literature, and has been reprinted many times and translated into many languages.

Gibbon stressed politics, religion, and war in his history, but he neglected economic and social forces. His chapters dealing with early Christianity caused many disputes, because of his ironical approach. He also planned a large-scale work on English history, but he died before accomplishing anything specific.

Some of the Six-Sided Basalt Columns forming the Giant's Causeway in Northern Ireland are 20 feet high.

De Cou, Sawders





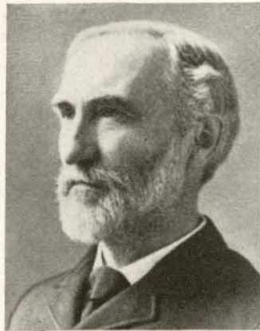
Brown Bros.

Edward Gibbon



Ewing Galloway

James Gibbons



Historical Picture Service

Josiah Willard Gibbs

Born near London of wealthy parents, Gibbon spent 14 months at Oxford University. He then lived for five years in Lausanne, Switzerland. He served as captain in the British militia during the Seven Years' War, but saw no action. After traveling in Europe, he settled in London in 1768 and spent the next 20 years writing his famous history. He was a member of Parliament between 1774 and 1783, and served for a time as a commissioner of trade and plantations. After 1783, Gibbon lived chiefly in Lausanne, although he died in London in 1794.

CHARLES F. MULLETT

GIBBONS, GRINLING. See FURNITURE (Late Jacobean, or Restoration).

GIBBONS, JAMES CARDINAL (1834-1921), was the second American to be created a cardinal of the Roman Catholic Church. He was a churchman of wide scholarship and influence. He began his education in Ireland, and remained there until he was 14. He studied at St. Charles College in Maryland and at St. Mary's Seminary in Baltimore, and was ordained a priest in 1861.

After serving as assistant in the parish of St. Patrick's in Baltimore, he was transferred to St. Bridget's in Canton, a suburb of Baltimore. Later, he became secretary to Archbishop Spalding. Gibbons rose to bishop and vicar apostolic of North Carolina. He was appointed bishop of Richmond, and archbishop of Baltimore in 1877. He was elevated to cardinal in 1886. He wrote several popular religious books, including *Faith of Our Fathers* (1882). Gibbons was born in Baltimore, Md.

JAMES A. CORBETT and FULTON J. SHEEN

GIBBONS, ORLANDO (1583?-1625), an English composer, wrote many church anthems and several secular anthems. He composed some music in the polyphonic style, but he favored solo voices with instrumental accompaniment (see POLYPHONY). His works include a fantasia in three parts for viol, many incidental pieces for keyboard and stringed instruments, and vocal compositions such as madrigals, motets, and street cries (see MUSIC [Motets and Madrigals]). He served at one time as organist in Westminster Abbey. Gibbons was born in Cambridge, and was graduated from Cambridge University in 1606, and from Oxford University in 1622.

WARREN S. FREEMAN

GIBBOUS MOON. See MOON (Phases of the Moon).

GIBBS, JOSIAH WILLARD (1839-1903), one of the greatest American mathematical physicists, might be called the father of modern physical chemistry. He made valuable contributions to the advance of thermodynamics, the study of heat (see THERMODYNAMICS).

His mathematical ideas were so far advanced that few American scientists understood his work. The great British scientist, James Clerk Maxwell, recognized Gibbs' genius (see MAXWELL, JAMES CLERK).

Gibbs' famous *Phase Rule* explained simply and logically the physical relationships among the different states of a substance, such as water, ice, and water vapor. His discoveries in pure science made possible

many new manufacturing methods in industry. His work helped advance biological and medical science. Gibbs' most famous book, *On the Equilibrium of Heterogeneous Substances*, was published between 1875 and 1878 in the *Transactions of the Connecticut Academy*.

Born in New Haven, Conn., Gibbs was the son of a Yale professor. He received his Ph.D. degree from Yale in 1863, and taught mathematical physics there throughout his life. He belonged to most of the great scientific societies of the world. In 1881, he received the Rumford medal from the American Academy in Boston, and in 1901 he was awarded the Copley medal from the Royal Society in England for his theory relating to the laws of heat. Gibbs received honorary degrees from Williams, Princeton, Erlangen, and Christiania universities. His bust was added to the Hall of Fame in 1950.

SIDNEY ROSEN

GIBRALTAR, *jih BRAWL tur*, is a British Crown Colony which occupies a rocky peninsula on the southern shores of Spain. Gibraltar is separated from the African coast by the narrow Strait of Gibraltar. It commands the western approach to the Mediterranean Sea, and, for this reason, is often called *The Key to the Mediterranean*. The British have made Gibraltar a strong fortress.

The Rock of Gibraltar is a limestone mass which rises 1,408 feet above the water and covers an area of about two square miles. It makes up almost the whole of the colony. The fortress itself is built in, above, and around the rock. The town of Gibraltar lies on the western and southern slopes of the peninsula.

Gibraltar is connected with the Spanish mainland by a low, sandy isthmus a mile and a half long and less than a mile wide. This strip forms a heavily guarded "neutral zone" between Spain and Gibraltar. An airfield now takes up part of the strip. The harbor is protected against submarine attacks by steel nets. Battleships and seaplanes also guard the base. The rock itself bristles with big guns. It is honeycombed with 10 miles of tunnels which contain ammunition stores, water tanks, food supplies, a hospital, and living quarters for the armed forces stationed there.

Gibraltar has a population of 23,232. Most of the people are of Spanish and Italian descent.

Gibraltar was known to the Greeks and to other early peoples as one of the two *Pillars of Hercules*. The other pillar stood across the Strait of Gibraltar on the African coast. In the 700's, Moorish invaders under a leader named Tarik crossed the strait and seized the

rock. They gave it the name *Gebel-at-Tarik* (Rock of Tarik), which later developed into the word Gibraltar. Moors and Spaniards fought over the rock for hundreds of years. English forces seized it in 1704, and the Treaty of Utrecht in 1713 gave official possession to Great Britain. The loss of Gibraltar was a great blow to Spain. For years, Spain made plans to recover the fortress. Finally in 1779, when England was fighting in the Revolutionary War in America, Spain tried to take Gibraltar. Spain formed a blockade around the fortress to starve the garrison. France came to the aid of Spain in 1780. The British were heavily outnumbered, but managed to withstand the blockade for over three years. A peace was signed in 1782, and Britain retained its hold on Gibraltar. The fortress served as a strategic Allied Mediterranean base during both world wars.

Gibraltar is the European home of the famous Barbary apes.

FREDERICK G. MARCHAM

See also BARBARY APE; GIBRALTAR, STRAIT OF; UTRECHT, PEACE OF.

GIBRALTAR OF THE EAST

GIBRALTAR, STRAIT OF, is a narrow body of water that connects the Mediterranean Sea and the Atlantic Ocean. The Strait is about 32 miles long and from 8 to 23 miles wide. It separates southernmost Spain from the northern coast of Africa. Cape Trafalgar in Spain and Cape Spartel in Tangier mark the western limits of the Strait; its eastern limits are the British Crown Colony of Gibraltar and Point Almina in North Africa. For location, see SPAIN (color map). On each side of the Strait at its eastern end is a huge rock. These rocks are called Pillars of Hercules. The Mediterranean receives waters that flow eastward from the Atlantic through the Strait. The sea has little tide, and its surplus waters are carried westward by an undercurrent which flows through the Strait of Gibraltar into the Atlantic Ocean.

WALTER G. LANGSAM

See also GIBRALTAR; PILLARS OF HERCULES.

GIBRALTAR OF AMERICA. See QUEBEC (city).

GIBRALTAR OF THE EAST. See SINGAPORE (History).



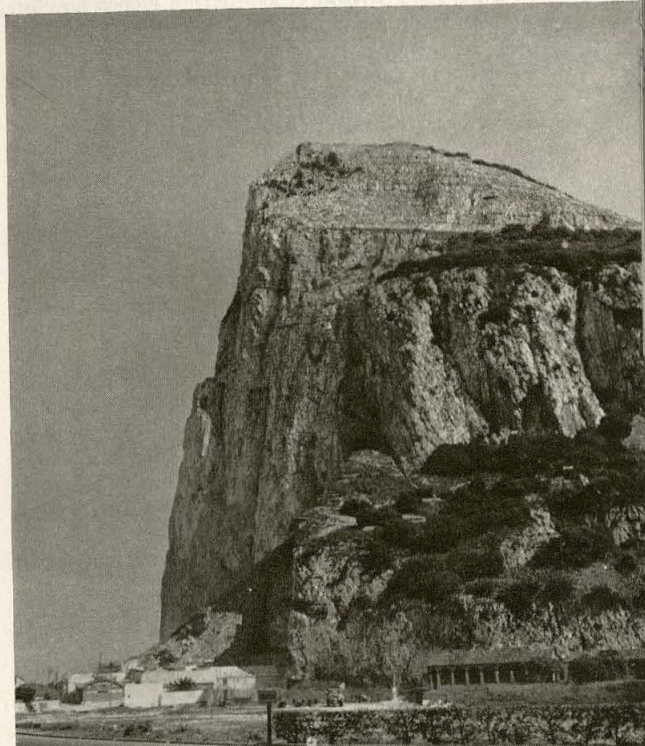
Camera Press—Pix

The Rock of Gibraltar guards the narrow passage between the Atlantic Ocean and the Mediterranean Sea. Great Britain maintains a naval base and airfield that are located on the west side of the rock, above.



Gibraltar Lies on a Peninsula off the Coast of Spain.

The Rock, as it is commonly called, has long stood as a symbol of strength and reliability. It towers 1,408 feet above the water, right. The British have held it for about 250 years.



GIBRAN, KAHILIL

GIBRAN, *jih BRAHN*, **KAHLIL** (1883-1931), was a Lebanese writer and painter. He wrote poetry, fiction, and nonfiction, both in Arabic and in English. His literature revealed a distinctive blending of Oriental

and Occidental philosophies of life. His novel, *The Prophet* (1923), gained great popularity. Gibran was also a serious painter, and many of his portraits and drawings are exhibited in leading galleries. He was born in Behirra, Lebanon, but left his homeland in 1894.

WALTER J. FISCHEL

GIBSON, ALTHEA. See TENNIS (Famous Tennis Players).

GIBSON, CHARLES DANA (1867-1944), an American illustrator, drew the famous "Gibson Girl." She was intended to represent a typical society woman. Gibson portrayed her in pen and ink drawings as an attractive, athletic, outdoor type who was poised and intelligent. The "Gibson Girl" became a



Culver

"The Gibson Girl" was created by the American artist Charles Dana Gibson.

favorite in the United States and many other countries during the 1890's and early 1900's. Gibson was born in Roxbury, Mass. He studied art in the United States and Europe.

NORMAN RICE

GIBSON, JOHN. See SCULPTURE (England).

GIDE, zheed, ANDRÉ (1869-1951), a French novelist, essayist, critic, and playwright, won the 1947 Nobel prize for literature. He usually drew on his own experiences in his novels and concerned himself with the search for new ethics to replace what he considered prejudices. He declared that he wrote to be re-read, and that his aim in writing was to disturb and to appeal to posterity, not to his timid contemporaries. His novels include *L'Immoraliste* (1902; English, *The Immoralist*, 1930); *La Porte Étroite* (1909; English, *Strait Is the Gate*, 1924); and *La Symphonie Pastorale* (1919; English, *The Pastoral Symphony*, 1931). He later wrote an ambitious

work, *Les Faux-Monnayeurs* (1926; English, *The Counterfeiters*, 1927), which had great experimental value, but was not as beautiful as his earlier novels. In 1909, Gide founded a monthly magazine, *La Nouvelle Revue Française*, which deeply influenced the literature and youth of France. Gide was born in Paris and was educated there.

HENRI PEYRE

GIDEON, *GID ee un*, was a judge and hero of Israel

who saved his people from the Midianites. The Bible (Judges 6-8) says that he went into battle with 300 followers, each armed with a sword, a trumpet, and an earthen lamp. They attacked at night. Gideon had faith in God, and victory was his.

GIDEONS INTERNATIONAL is an association of Christian businessmen. It was formed at Janesville, Wis., in 1899. Gideons carry on their work through church meetings, Bible classes, and civic organizations. It publishes a monthly magazine, *The Gideon*, at its headquarters, 212 E. Superior St., Chicago, Ill.

In 1908, the group began placing Bibles in hotel rooms. Gideons International distributed more than 5,500,000 Bibles and about 35,000,000 New Testaments with Psalms and Proverbs to hotels, hospitals, prisons, public schools, YMCA's, and military camps. The group is active in about 45 countries. M. A. HENDERSON

GIELGUD, GILL good, SIR JOHN (1904-), became one of the greatest British actors of the 1900's. He enjoyed greatest successes in plays of Shakespeare, especially in *Hamlet*, but he played many roles, ranging from deep tragedy to light farce. Gielgud was born in London. He came from a distinguished theatrical family, of which the most famous member was Ellen Terry, his great-aunt (see TERRY, ELLEN A.). He was knighted in 1953.

LEO HUGHES

GIESEKING, GEE zuh king, WALTER (1895-1956), a German pianist, became famous for his ability to play both massive works by such composers as Beethoven and delicate pieces as those by Debussy and Ravel. He was born in Lyon, France, the son of a German doctor. His family traveled widely, and he received a private education. He had formal training at the Hanover Conservatory, and made his concert debut in 1915. ROBERT U. NELSON

GIFFARD, HENRI. See AIRSHIP (History).

GIFT OF THE NILE. See EGYPT, ANCIENT.

GIG. See BUGGY.

GIGLI, JEEL yee, BENIAMINO (1890-1957), was an Italian tenor. A singer with an international reputation, he sang in Italy, the United States, England, Germany, Austria, and throughout South America. Music lovers and critics alike praised his "golden tone," and held him to be an equal of Enrico Caruso (see CARUSO, ENRICO). Gigli sang leading roles in many major Italian operas, including *Tosca*, *La Bohème*, *La Traviata*, *L'Africaine*, and *Madame Butterfly* (see OPERA [Some of the Famous Operas]).

Gigli was born at Recanati, Italy. He made his opera debut in 1914. Recognition of his talent came quickly,

and he soon appeared in all the major European opera houses. He sang with the Metropolitan Opera of New York. MARTIAL SINGER

Beniamino Gigli

Metropolitan Opera



GIGUE, zheeg, or GIGA, was originally a lively, rustic dance popular in England, Scotland, and Ireland. In the 1500's, it became popular with composers as part of the suite (see SUITE). The gigue has a triple rhythm and is in simple binary form, that is, divided into two sections.

André Gide

Daniel Filipacchi, from *Paris Match*



The Gila Monster received its name from the Gila River, which flows through the part of Arizona where it was first discovered. It ranks as one of the largest members of the lizard family in North America.



Balestrero, Western Ways

GILA CLIFF DWELLINGS NATIONAL MONUMENT

lies in southwestern New Mexico, in the Gila Wilderness Area. The 160-acre monument was established in 1907, and contains many cliff-dweller ruins.

The Gila cliff dwellings are located about 150 feet up in the sheer walls of a small, wooded canyon. The dwellings are constructed of stone, mud, and timbers. The cliff-dwelling Indians who lived there farmed the rich bottom lands in the canyon.

See also **CLIFF DWELLERS**.

GILA, *HEE luh*, **MONSTER** is a large poisonous lizard. It lives in deserts of the southwestern United States and northern Mexico. This reptile and its relative, the Mexican beaded lizard, are the only poisonous lizards known.

The Gila monster usually grows to a length of about 18 inches. It has a stout body, broad blunt head, and stumpy tail. The head and body have areas of black or brown, and of orange or salmon. The thick tail is a storage place for fat. The Gila monster can live on this stored-up fat for months without eating.

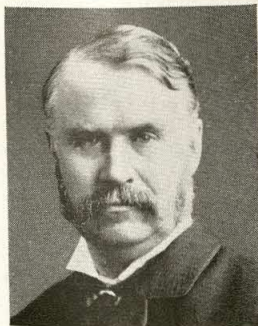
Gila monsters come out at night, or at other cool times. They eat bird and reptile eggs, and small animals. The female buries her eggs where they will be hatched by the heat of the sun.

The Gila monster has a powerful *venom*, or poison, but a poor way of using it. The venom enters the reptile's mouth along the base of the teeth, which have grooves. When the lizard bites, these grooves carry venom into the holes or wounds made by the teeth. An enraged Gila monster will often chew its victim, and thus work the venom into the flesh.

Scientific Classification. The Gila monster is in the family *Helodermatidae*. It is genus *Heloderma*, species *suspectum*.

CLIFFORD H. POPE

See also **LIZARD**.



Brown Bros.

Sir William Gilbert, left, wrote the words for the popular Gilbert-Sullivan light operas. Gilbert and Sullivan, right, discuss the score during a rehearsal of *H.M.S. Pinafore*, one of their most popular works. This painting is one of a series of events in the lives of immortal composers, painted for the Magnavox collection by Walter Richards.

GILA RIVER, in Arizona and New Mexico, helps farmers grow crops in the desert and generates electric power. Since 1928, when Coolidge Dam was completed, the river has been used to irrigate nearly 100,000 acres. Prehistoric Indians also used its waters for irrigating land. The Gila River is 630 miles long. It rises in the Mogollon Mountains of New Mexico, and flows west across Arizona to empty into the Colorado River near Yuma. For location, see **ARIZONA** (color map). See also **COOLIDGE DAM**; **GADSDEN PURCHASE**. ALICE B. GOOD

GILBERT, SIR ALFRED. See **SCULPTURE** (England).

GILBERT, SIR HUMPHREY (1539?-1583), an English scholar and soldier, became famous as a navigator and explorer. He believed there was a northwest passage by water across the American continent that would lead to the East Indies. He wrote an essay about his theory in 1576, which interested Queen Elizabeth I. In 1578, she gave him permission to sail in search of a passage. Little is known about the voyage. Gilbert returned to England after losing one of his best ships and one of his bravest captains.

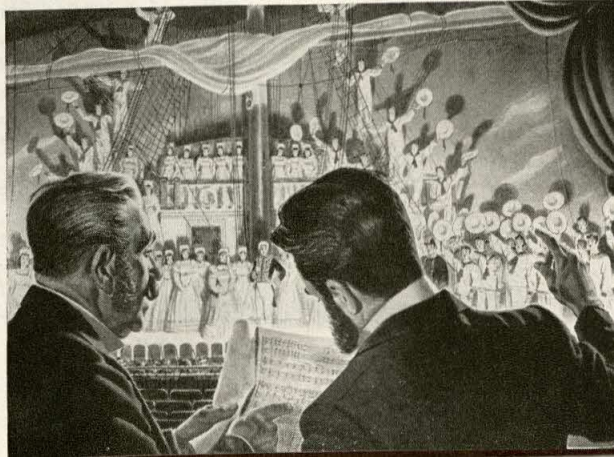
He started out again in 1583 in command of another expedition. His half brother, Sir Walter Raleigh, started with him. Raleigh and his men turned back two days after they left Plymouth, but Gilbert went on. He succeeded in founding a colony near St. John's, Newfoundland, and took possession of the land in the queen's name. Gilbert and his crew were lost on the way back to England.

JAMES G. ALLEN

See also **CANADA**, **HISTORY OF** (color picture); **NORTHWEST PASSAGE**.

GILBERT, WILLIAM. See **ELECTRICITY** (History).

GILBERT, SIR WILLIAM SCHWENCK (1836-1911), was a British wit and writer of light opera. About 10 of these operas, with music composed by Sir Arthur Sullivan,



GILBERT ISLANDS

still attract enthusiastic audiences. Gilbert and Sullivan produced such operas as *H.M.S. Pinafore*, *The Pirates of Penzance*, *Patience*, *Iolanthe*, *The Mikado*, and *The Gondoliers*. During the run of *Patience*, D'Oyly Carte, their manager, built them the Savoy Theater. The success of their operas seems to rest on the happy combination of Gilbert's fantasy and satire, and Sullivan's music (see SULLIVAN, SIR ARTHUR SEYMOUR).

Gilbert was born in London. After being graduated from the University of London, he became a civil servant and later a lawyer. But he disliked both occupations so much that he began to write. Gilbert worked for a time on the staff of *Fun*, a magazine in which his *Bab Ballads* appeared. Then theatrical friends influenced him to write for the stage, and his real career began. Gilbert was knighted when he was past 70. LEO HUGHES

GILBERT ISLANDS are a group of 16 low coral reef islands in the central Pacific Ocean. They have no mountains or rivers, and are not more than 20 feet above sea level at any point. Their total area is 114 square miles. The islands were named for a British captain who explored them in 1788. Tarawa is the best known of the Gilbert Islands, because of the bloody battle fought there in World War II. See TARAWA.

The islands form part of *Micronesia*, or the *little islands*. They have been under British protection since 1892. In 1916, with the Ellice Islands, they became part of a crown colony. Other islands in the colony include Christmas, Fanning, and Washington, in the Line Islands; Ocean Island; and some of the Phoenix Islands.

About 28,000 people live on the Gilbert Islands. There are a few Europeans and some Asiatics, but most residents are native islanders. They are slim, but sturdy, and have light-brown skin. The women wear knee-length skirts of split coconut leaves, but most men wear cloth garments. Their houses have thatched roofs of pandanus leaves. Copra, the dried meat of coconuts, is the chief export.

EDWIN H. BRYAN, JR.

See also ELLICE ISLANDS; LINE ISLANDS; PACIFIC ISLANDS (Micronesia); PACIFIC OCEAN (color map); PHOENIX ISLANDS.

GILBRETH, FRANK BUNKER (1868-1924), was an American engineer and management consultant. His search for administrative improvements led him to develop "time and motion" study as an approach to scientific management. In 1911, with his wife, Lillian Evelyn Gilbreth, he established a firm of consulting industrial engineers.

Gilbreth was born at Fairfield, Me. A high-school graduate, he worked up from bricklayers' apprentice to become general superintendent of a construction firm. His general contracting business, started in 1895, handled jobs throughout the world. Gilbreth's family of 12 children became famous when two of them, Frank B. Gilbreth, Jr., and Ernestine Gilbreth Carey, wrote *Cheaper by the Dozen* (1949). ROBERT E. SCHOFIELD

GILD. See GUILD.

GILDED AGE. See UNITED STATES, HISTORY OF (The Gilded Age).

GILDING is the art of applying gold leaf or gold dust to metal, porcelain, wood, paper, glass, or other material. The oldest and best method is to apply gold leaf to a surface which has first been treated with a prepara-

tion called *sizing*. When the sizing is partly dry, it acts like glue and holds the gold leaf firmly in place. Two applications of sizing are needed to make the gold leaf stick to cardboard or paper, because the material may absorb the first coating.

Mirror and picture frames or moldings can be gilded with gold or silver leaf. An application of yellow varnish protects the gilding. Gold dust is applied to book edges after they are first coated with glue, usually fish glue.

To gild china, glass, and pottery, gold dust is mixed to form a paint, and applied with a brush. To make the gilding last, the article is baked first in an oven at low temperature and then in a kiln at high temperature. The alkali in soap sometimes eats the gold off dishes, if they are washed too often and not well rinsed. Gold leaf is applied to iron and steel after the clean surface has been heated until it turns bluish.

Buildings often are decorated with gold leaf. Gilding is used to decorate with richness the interior of Saint Peter's Church in Rome, and the Library of Congress in Washington, D.C. Gold leaf covers the dome of the State House in Boston.

WILLIAM M. MILLIKEN

See also ELECTROPLATING; GOLD (Other Uses).

GILEAD, GILL *ee ud*, was the name given in the Bible to part of the land lying east of the River Jordan in ancient Israel. The tribes of Reuben and Gad and half the tribe of Manasseh occupied this land. The Ammonites, farther to the east, made various attempts to capture Gilead. Jephthah, and later King Saul, defeated the Ammonites. After Saul's death, his son tried to rule all Israel from a capital in Gilead. David's rebellious son Absalom was killed there. W. W. SLOAN

GILEAD, BALM OF. See BALM OF GILEAD.

GILL, gil, is the breathing organ of many animals that live in the water. It does the same work as the lung of an animal that lives on land. Most fishes breathe with gills. These organs are inside hollow places on each side of the body just back of the head. If you examine the throat of a fish, you will see four or more slits which open to the outside. These are called *gill-openings*.

In bony fishes the gills cannot be seen until the hard *gill covers* are turned back or removed. The gill slits of lampreys and sharks are not covered and can be seen from the outside. When a fish breathes, it opens its mouth at regular times and draws in a mouthful of water. It then draws the sides of its throat together. This forces the water through the gill openings. The water passes over the gills to the outside. Valves in the mouth keep water from escaping through the mouth again.

The gill itself has the form of plates, branches, or threads of very thin membrane. They are so thin that oxygen dissolved in the water can pass through into the blood vessels of the gills. The oxygen is then carried by the blood to other parts of the body. Carbon dioxide, a waste product, passes from the blood through the gills into the water. Gills or gill-like organs are found also in mollusks, crustaceans, and some insects. CARL L. HUBBS

See also LUNG.

GILL, in measure. See WEIGHTS AND MEASURES (Liquid Capacity Measure).

GILL, in mushroom. See MUSHROOM (Parts).

GILL-OVER-THE-GROUND. See IVY.

GILLES. See BELGIUM (Way of Life; picture).

GILLESPIE, "DIZZY," JOHN B. See JAZZ (Famous Jazz Musicians; picture).

GILLETTE, WILLIAM HOOKER (1853-1937), an American actor and dramatist, became famous in the title role in *Sherlock Holmes*. No other actor equaled his remarkable performance in the play which he adapted from Sir Arthur Conan Doyle's stories (see DOYLE, SIR ARTHUR CONAN). Gillette was born in Hartford, Conn. He went on the stage before he was 20, and soon starred in plays that he wrote.

WILLIAM VAN LENNEP

GILLS, in mushrooms. See MUSHROOM (Parts; diagram).

GILLYFLOWER. See WALLFLOWER.

GILMAN, DANIEL COIT (1831-1908), was an American educator and scientist. He served as president of the University of California from 1872 to 1875; of Johns Hopkins University from 1875 to 1901; and of Carnegie Institution from 1901 to 1904. Gilman introduced an advanced school of arts and sciences at Johns Hopkins.

Gilman was born in Norwich, Conn. He was graduated from Yale University in 1852, and taught there after serving as an attaché of the American embassy in Saint Petersburg (now Leningrad).

CLAUDE A. EGGERTSEN

GILMAN, NICHOLAS (1755-1814), was a signer of the United States Constitution. He was born in Exeter, N.H., and fought in the Revolutionary War. He served in the Continental Congress from 1786 to 1788. Although he did not have an important part in the work of the Constitutional Convention, Gilman strongly urged his state, New Hampshire, to ratify the Constitution. As a United States Representative from 1789 to 1797, he supported the Federalist party. Gilman was a United States Senator from 1805 to 1814 and then favored the Republican party.

ROBERT J. TAYLOR

GILPIN, WILLIAM. See COLORADO (Famous Coloradans).

GILSONITE. See ASPHALT.

GIMBAL. See COMPASS (Deviation); GYROSCOPE (Parts of a Gyroscope).

GIMMAL FLASK. See GLASSWARE (Early Glassware).

GIN. See ALCOHOLIC DRINK (Compounded Liquors).

GIN, COTTON. See COTTON GIN.

GIN RUMMY. See RUMMY.

GINGER, *JIN jir*, is a spice, a popular flavoring. It comes from the roots of the ginger plant, a native of

GINGIVITIS

the East Indies introduced into Japan, the West Indies, South America, and West Africa.

The stems and grasslike leaves of the plant spring directly from the knotty root-bearing *rhizome*, or underground stem. On the stems grow clusters of white flowers, streaked with purple. To make black ginger the roots are dug up and dried whole after the leaves wither.

To make white ginger the roots are scraped and washed before they are dried. The ginger can be preserved if it is boiled and dipped in sirup every 24 hours for a week. The finest ginger comes from Puerto Rico and Jamaica. It is generally sold in the form of an extract. However, most preserved ginger is imported from China.

Ginger is used as a spice to flavor foods such as gingerbread and gingersnaps. It also is used to make ginger tea, a home remedy for stomach-ache. Most people have tasted candied ginger, and the popular drinks, ginger ale and ginger beer. Ginger wine is cheap liquor flavored with ginger. Oil of ginger is used as a medicine, internally for the stomach, and externally for pains, like toothache. Its most common use is to season many kinds of food.

Wild ginger is a plant of the birthwort family, and is not related to true ginger. It grows in the shady woodlands of the northern United States. Wild ginger is a low, woolly plant, with heart-shaped leaves. It has one bell-shaped brownish-purple blossom. It grows close to the ground or on it, where crawling beetles and ants can easily reach it with pollen. Like true ginger, its root is a stimulant, and it also is used as a spice.

Scientific Classification. Commercial ginger is in the family *Zingiberaceae*. It is genus *Zingiber*, species *officinale*. Wild ginger is in the family *Aristolochiaceae*. It is *Asarum canadense*.

HAROLD NORMAN MOLDENKE

See also CARDAMOM.

GINGERBREAD TREE. See DOOM PALM.

GINGHAM, *GING um*, is a cloth, or fabric, used in dresses, curtains, and furniture covers. It is made of colored yarns in a plain weave and may be striped, checked, or plaid. The cloth varies in width from 26 to 32 inches. Fabrics in the gingham family include chambray, shirting, madras, cheviot shirting, apron check, nurses' stripe, tissue gingham, and fine Scotch-type gingham.

GRACE G. DENNY

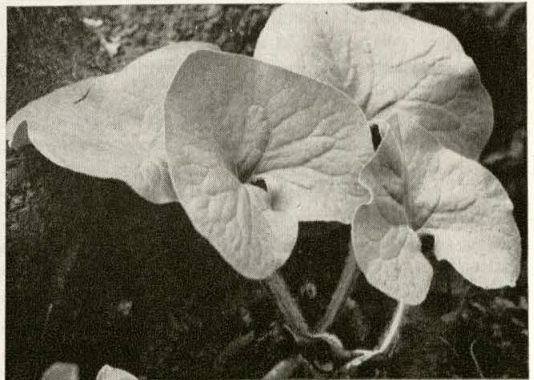
GINGIVITIS. See TEETH (Diseases and Defects).

Gordon S. Pearsall



Ginger Plants, left, important for the spice obtained from the roots, are grown in many parts of the world and shipped to the United States. The roots are carefully dried and peeled before shipping.

Wild Ginger, right, common in American woodlands, has low-growing leaves and three-petaled flowers.





L. W. Brownell

The Chinese Ginkgo has fan-shaped leaves that look much like fern fronds. It is sometimes called "maidenhair tree." The branches tend to spread out as the trees grow older.

GINKGO, *GING koh*, or **MAIDENHAIR TREE**, is the only surviving species of an order, or group, of plants that lived millions of years ago. It was discovered growing in temple gardens in China and Japan.

Ginkgoes are slender trees with fan-shaped, fernlike leaves that grow on the ends of shoots. The fruit resembles a plum and contains a nut that is edible when roasted. But the flesh surrounding the nut smells like rancid butter. The male forms of the ginkgo, which do not bear fruit, are often planted as ornamental trees in the United States.

Scientific Classification. The ginkgo belongs to the family *Ginkgoaceae*. It is classified as genus *Ginkgo*, species *biloba*.

RICHARD J. PRESTON, JR.

See also ALABAMA (Interesting Places to Visit); TREE (picture, Tree Shapes); WASHINGTON (State Parks).

GINSENG, *JIN seng*, is an herb with a long fleshy root that is used as a medicine. It is a low plant with three leaves at the top. Each leaf is made up of five leaflets. Ginseng has small greenish-yellow flowers. Some of these flowers later change to scarlet berries. The Chinese believe that ginseng will cure nearly every disease. The name of this plant comes from Chinese words meaning *likeness of a man*, because of the shape of its root. Those shaped most like a human body are really worth their weight in gold to the Chinese.

American ginseng is better than Chinese or Korean varieties. The plant used to grow wild in the United States and Canada, but the great demand used up this supply, and it is now cultivated. Ginseng is raised in beds, under a covering of latticework to protect it from the heat of the sun, which kills it.

Scientific Classification. Ginseng is a member of the family *Araliaceae*. The American species is classified as genus *Panax*, species *quinquefolium*. The Chinese species is *P. ginseng*.

HAROLD NORMAN MOLDENKE

Ginseng has tiny flowers and five-pronged leaves, right above. The Chinese value the roots, below, for medicine.

New York Botanical Gardens; A. C. Parsons

GIORGIONE, *johr JOH nay* (1478?-1510), was the first of many artists who made Venice the world's center of painting for more than 100 years. Through his more famous follower Titian, who lived longer and made more paintings, Giorgione influenced one aspect of methods painters still use (see **TITIAN**). He worked to achieve a unity between human figures and their surroundings. Before his time, painters had looked at figures and landscapes separately (see **PAINTING [Figures]**). Giorgione suggested this unity through a vibrating method of applying paint to make it look sketchy and lively, rather than smooth and fixed. He used not only light and dark gray shadow but all colors to show light and shade transitions, so that brilliance and life are represented through colored light. This method of applying paint aided in suggesting his mood, which tended to be thoughtful, sometimes dreamy, and yet subtle.

Among the most famous of his works are *The Storm*, *The Sleeping Venus*, and *The Rustic Concert*. The painting, *The Adoration of the Shepherds*, which some historians believe is his work, appears in color in the **PAINTING** article.

Giorgione was born in Castelfranco, Italy. He was called **GIORGIONE DA CASTELFRANCO**. CREIGHTON GILBERT

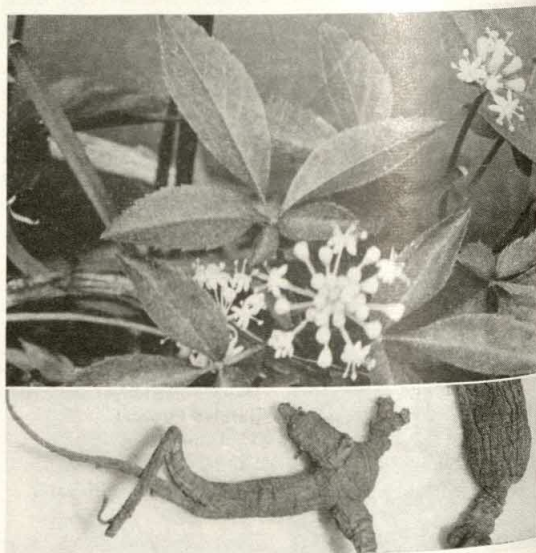
GIOTTO, *JAWT toh* (1266?-1337), was the greatest artist of the early Italian Renaissance. His works mark the beginning of the Renaissance in painting. Before his time, Italian art had been stiff and conventional, but Giotto helped to make it free and graceful. He painted men and women who looked real, and whose feelings could be understood. He followed Cimabue in developing the backgrounds of paintings (see **CIMABUE**, **GIOVANNI**).

He is best known for his *frescoes*, or wall paintings, of



Historical Pictures Service

Giorgione





Brown Bros.



Culver

Giotto di Bondone, left, painted human emotions with dramatic force, giving his men and women both dignity and humility. *Flight into Egypt*, above, one of his finest frescoes, is in the Arena Chapel in Padua, Italy.

the lives of St. Francis of Assisi, the Virgin Mary, and Jesus Christ. One of his paintings, *The Descent from the Cross*, appears in color in the **PAINTING** article. His frescoes are in the Arena Chapel in Padua, the Upper Church in Assisi, and the Church of Santa Croce in Florence.

His famous painting, *The Madonna Enthroned*, is in the Uffizi Gallery in Florence.

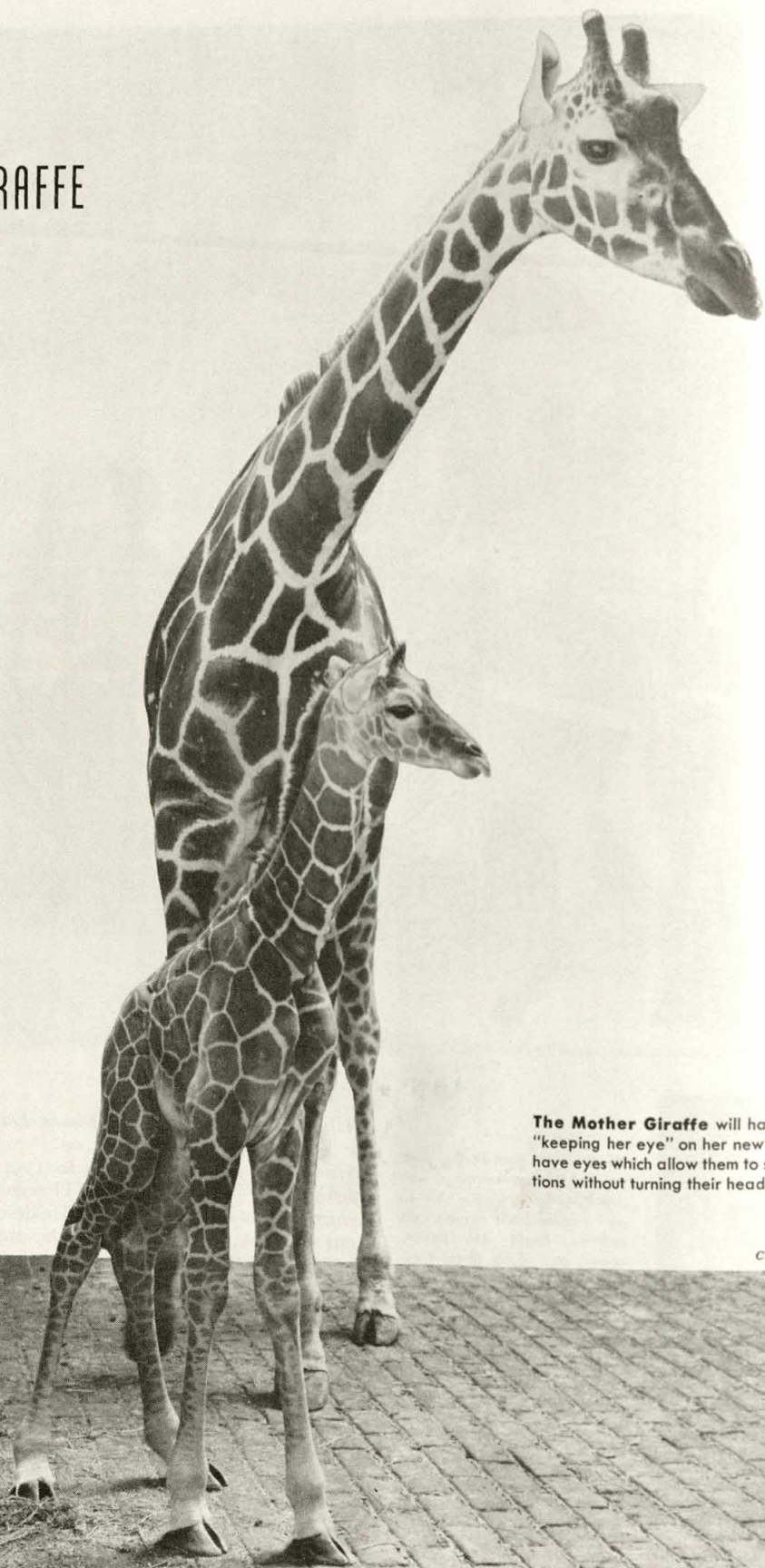
Giotto was also an architect. In 1334 he became chief architect of the cathedral of Florence, one of the greatest honors conferred on him. He designed the famous *campanile*, or bell tower, for the cathedral. It is usually called *Giotto's Tower*. The tower is delicate in design and rich in decoration. At the time of Giotto's death, the campanile was unfinished, but he left a perfect model, and the tower was completed by several of his pupils.

Giotto was born **GIOTTO DI BONDONE** in a village near Florence. He became a leading figure in Florence, and such prominent Italian writers as Dante, Petrarch, and Boccaccio mentioned him in their works. Giotto was revered by Florentine painters throughout the entire period of the Renaissance.

WOLFGANG LOTZ

GIPSY. See **GYPSY**.

GIRAFFE



The Mother Giraffe will have little trouble "keeping her eye" on her new baby. Giraffes have eyes which allow them to see in all directions without turning their heads.

Chicago Daily News

GIRAFFE, *jih RAHF*, is the tallest of all animals. A full-grown male giraffe may be 18 feet or more high. Africa is the only place where giraffes live wild. Large numbers of them are found only on the dry plains south of the Sahara. With the okapi they form a separate family among the cud-chewing mammals, or *ruminants*.

The great height of the giraffe is due to its long, slender legs and its extremely long neck. But the neck, though it may be over 6 feet long, has only the usual seven neckbones, or vertebrae. The body is short and slopes sharply down to the tail, which ends in a tuft of hair. The front legs appear to be longer than the hind ones, but they are all the same length. The feet have cloven hoofs. On the long head are two moderate-sized ears. Between them is a pair of short bony projections resembling horns. There also is a third bony projection a little lower down on the skull. The giraffe has large, dark eyes and long lashes. The animal can close its nostrils completely. This keeps out sand and other irritating particles. The giraffe has a long upper lip and an 18-inch tongue, with which it tears twigs and leaves from trees. A baby giraffe, or *colt*, is about 6 feet tall at birth. It can often care for itself by the time it is 3 months old, but does not reach maturity until it is 6 to 8 years old.

Some giraffes are a pale tawny color, marked with chestnut or brown patches. Others are chestnut color, with a network of tawny lines. The animal's hair is short and smooth, except for a short mane on its neck. Because its front legs are so long, the animal must spread them far apart when it drinks, or grazes on short plants. The giraffe has a poorly developed voice box, or *larynx*, which it seldom uses. Giraffes in zoos have been heard to utter a soft "moo." In captivity a giraffe requires careful attention and constant care.

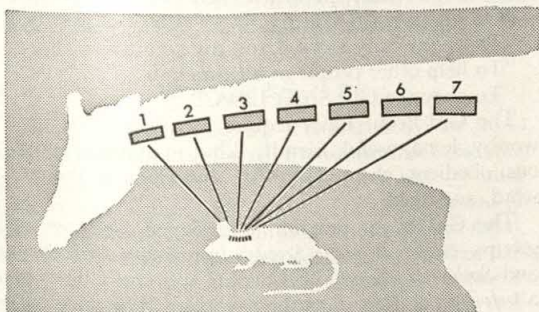
The giraffe has keen smell, hearing, and sight. It walks swiftly with a pacing gait. When it is alarmed or pursued, the giraffe runs with a fast rocking gallop like that of a camel. It is not easily overtaken, even by a horse. But when once overtaken, it can be killed easily.

The name *camelopard* for the giraffe is now obsolete. The giraffe was given this name because it is formed somewhat like a camel, and is spotted like a leopard.

Scientific Classification. The giraffe belongs to the family *Giraffidae*. The common giraffe is genus *Giraffa*, species *camelopardalis*. The Somali giraffe is *G. reticulata*.

VICTOR H. CAHALANE

See also ANIMAL (color picture, Africa); OKAPI; RUMINANT.



Adapted from *Man in Structure and Function* by Fritz Kahn, by permission of and special arrangement with Alfred A. Knopf, Inc.

The Giraffe's Neck and the Neck of a Mouse are quite different in size, but they have the same number of bones.

GIRL RESERVES

GIRARD, STEPHEN (1750-1831), was an American businessman and philanthropist. He helped the United States government finance the War of 1812, and played an important part in founding the Second Bank of the United States (see BANK OF THE UNITED STATES). He is noted for leaving his fortune to charitable purposes. Girard College, a school for male orphans in Philadelphia, was founded with the bulk of his estate.

Girard was born in Bordeaux, France. He went to sea as a boy, and settled in Philadelphia in 1776. He became a merchant, and carried on extensive trade with the West Indies, Europe, and Asia. He gave generously of his time and money during a yellow fever epidemic in 1793.

ROBERT H. BREMNER

GIRARD COLLEGE is an elementary and high school for boys at Philadelphia. The school is controlled by the Philadelphia board of directors of city trusts. Girard gives a normal elementary and high-school course, with emphasis on mechanics and other vocational subjects. The school was founded in 1848. Poor male orphans from 6 to 18 years old make up the student body of Girard. About 965 boys attend.

E. NEWBOLD COOPER

GIRARDEAU, CAPE. See CAPE GIRARDEAU.

GIRARDON, FRANÇOIS. See SCULPTURE (France).

GIRASOL. See OPAL.

GIRAUD, ZHEE ROH, HENRI HONORÉ, *ahn REE oh-no RAY* (1879-1949), a French professional soldier, served as High Commissioner of North Africa in 1942 and 1943, and as chief of the French armed forces from 1942 to 1944. The Germans took him prisoner in 1940, but he escaped to Algiers in 1942. The Allies selected him as French leader in North Africa. He served with Charles de Gaulle for a time as co-chairman of the Committee of National Liberation. Giraud retired from the army in 1944. He was born in Paris.

E. J. KNAPTON

GIRAUDOUX, ZHIH ROH DOO, JEAN (1882-1944), a French author, began to write plays late in his career and won immediate success as a dramatist. Several of his dramas—*Amphitryon 38*, *The Madwoman of Chaillet*, and *Tiger at the Gates*—delighted audiences in London and New York City. His favorite themes were war, man's fight against fatality, and the delight of love and of life serenely accepted. Giraudoux was born at Bellac. He lectured at Harvard University.

HENRI PEYRE

GIRDER. See BUILDING CONSTRUCTION (Parts of a Building).

GIRL GUIDES is an international organization for girls between the ages of 7 and 18. The movement began in England soon after Lord Baden-Powell introduced the Boy Scout movement there. In 1909, Baden-Powell extended official recognition to the Guides and also published the book *Scheme of Training for Girl Guides*. His sister, Agnes Baden-Powell, served as first commissioner of the Girl Guides and helped organize the Girl Guides Association. By 1910, the Girl Guides movement had spread to many other parts of the British Commonwealth and also to other countries in the world. The organization is called Girl Scouts in the United States and its possessions.

See also BADEN-POWELL, LORD; GIRL SCOUTS.

GIRL OF THE GOLDEN WEST. See OPERA (Some of the Famous Operas).

GIRL RESERVES. See Y-TEENS.

GIRL SCOUTS



Girl Scout Emblem

Senior Scouts, girls from 14 through 17, wear hats and two-piece dresses made of dark-green cotton sharkskin.



Girl Scouts of the U.S.A.

Brownies, the youngest girls in the Girl Scout movement, wear brown felt beanies and one-piece dresses of light-brown broadcloth.

Intermediate Scouts, who range in age from 10 through 13, wear dark green woolen berets and one-piece belted dresses.

GIRL SCOUTS is an organization for girls between the ages of 7 and 17. Members learn the highest ideals of character and patriotism while they enjoy a program of work, play, and companionship. Girl Scouts learn to protect their health, practice useful skills, and become good citizens of their communities.

More than 3,000,000 members, including about 700,000 adult leaders, belong to the Girl Scouts of the United States of America. The organization also has units in 48 other countries where United States citizens live. In some countries, Girl Scouts are called Girl Guides. Canada has more than 130,000 Girl Guides. The Girl Scouts and Girl Guides make up an international movement called the World Association of Girl Guides and Girl Scouts, founded in 1928.

Girl Scouts are united by a belief in God and by the

Girl Scout Promise, in which each girl solemnly says:

"On my honor, I will try
 "To do my duty to God and my country,
 "To help other people at all times,
 "To obey the Girl Scout Laws."

The Girl Scout Laws require members to be trustworthy, loyal, useful, friendly, kind to animals, courteous, obedient, cheerful, thrifty, and clean in thought, word, and deed.

The Girl Scout program is designed for three age groups, called *Brownie Scouts*, *Intermediate Girl Scouts*, and *Senior Girl Scouts*. Girl Scouts and Girl Guides use a *trefoil*, or cloverleaf, as their emblem. The three parts of the trefoil stand for the three parts of the Girl Scout Promise. The symbol of the Girl Scouts of the United States has an American eagle and the letters "GS"



Girl Scouts of America

Combining Patriotism and Sewing, these Intermediate Scouts work to earn the My Country badge.

Camping Out, Senior Scouts take part in a Senior roundup. They wear special uniforms designed for the event.

Paul Parker



Caring for Baby, an Intermediate Scout earns the Child Care badge. She wears her badges on her right sleeve.



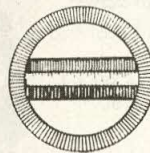
Paul Parker

Proficiency Badges show that a Girl Scout has gained skill in any one of 115 fields.

Child Care



My Country



Camp Craft



on the face of the trefoil. Members try to follow their motto, "Be Prepared," and to uphold their slogan, "Do a good turn daily." They are trained to do a job well.

What Girl Scouts Do

The Girl Scout program includes activities in 11 fields: (1) arts and crafts, (2) literature and dramatics, (3) music and dancing, (4) community life, (5) international friendship, (6) nature, (7) out-of-doors, (8) sports and games, (9) agriculture, (10) health and safety, and (11) homemaking. Girls learn new hobbies and skills, and have opportunities for fun and adventure in each of these fields. They develop self-reliance, self-control, and eagerness to serve others.

Brownies, the youngest Girl Scouts, are 7 through 9 years old. They learn to get along in their group, to

take care of themselves, and to help their families and communities. They also learn the special Brownie Scout salute and handshake, and the Brownie Promise:

"I promise to do my best
"To love God and my country
"To help other people every day,
"Especially those at home."

To become a Brownie, a girl must attend one meeting a week for four weeks. She must learn the Brownie Promise and what it means to be a Brownie. Then, at a ceremony called an *investiture*, the leader of her *troop*, or unit, pins a Brownie pin on the right-hand collar of her uniform. Sir Robert Baden-Powell, who founded the Boy Scouts and Girl Scouts, gave the Brownies their name. He thought the name of England's elves would fit girls who like to be useful as well as to play.

GIRL SCOUTS

An adult leader supervises the Brownies. But they run their own troops, and decide the things they want to do. Sometimes they go for walks and picnics to study nature, or they may plant a garden or study the history of their neighborhood. They also sing, dance, draw, paint, dramatize stories, and take part in other creative activities. They learn to keep their meeting place and play area clean. They practice using kitchen utensils and following recipes so they can be helpful at home. Brownies make tea towels, trays, and scrapbooks for sick persons. They visit elderly people and handicapped youngsters, taking gifts on birthdays and holidays.

Intermediate Scouts are 10 through 13 years old. When a Brownie becomes 9, she prepares to advance to *Intermediate Scout* by studying the *Girl Scout Handbook*. When she reaches the age of 10, she takes part in a *Fly-up* ceremony and receives a pair of embroidered wings to sew on her uniform. The wings show that she was a Brownie before she became an Intermediate Scout. But any girl, whether or not she has been a Brownie, may become an Intermediate Scout. To enter this phase of Scouting, a girl must make the Girl Scout Promise and agree to uphold the Girl Scout Laws. The Intermediate Scout program has four ranks: *Tenderfoot*, *Second Class* and *First Class Girl Scouts*, and *Curved Bar*.

Tenderfoot Scouts complete at least one activity in

each of the 11 fields of interest in Girl Scouting. For example, a *Tenderfoot* may make an ornamental design and use it on woodwork, leather, or metal to fulfill her requirement in the field of arts and crafts. In the literature and dramatics field, she may join other Scouts in dramatizing a story. When she completes all the required activities, she becomes a *Second Class Scout*.

Second Class Girl Scouts work to earn *proficiency badges* which show that they have become skilled in any of 115 subjects. These subjects include drawing and painting, woodworking, weaving, sewing, and interior decorating. A Girl Scout learns that it is not how many things she can do, but how well she can do them, that counts. Girl Scouts collect badges to show their progress, not just to decorate their uniforms. They usually take about three months to earn a badge. A *Second Class Scout* must complete six specific requirements, including earning 10 proficiency badges, to become a *First Class Scout*. At least four of her badges must be in one main field of interest. She also completes all *Second Class* requirements, and plans and carries out projects in the community, the home, the arts, and out-of-doors.

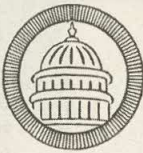
First Class Girl Scouts work to achieve new skills and earn new proficiency badges. When a girl earns four additional badges in the arts, citizenship, homemaking, or out-of-doors, she advances to the *Curved Bar*, the highest rank in intermediate Scouting.

Senior Scouts are 14 through 17 years of age. Their

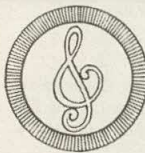
Painting



My Government



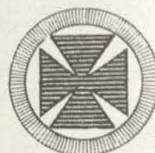
Musician



My World



First Aid



Cook



The Girl Scout Laws:

Planting a Tree, Brownies learn how important it is to conserve natural resources even near their school.



1. A Girl Scout's honor is to be trusted.



3. A Girl Scout's duty is to be useful and to help others.



2. A Girl Scout is loyal.

program stresses community service. It also gives girls a chance to find out what careers they would like to follow when they grow older. Senior Scouts have a five-point program: (1) out-of-doors, (2) hobbies, (3) service, (4) preparedness, and (5) Girl Scout-Council knowledge (learning about local organizations). A girl receives a *Five-Point Pin* when she finishes this program. Her insignia now indicate how long she has been a Girl Scout, her rank, and her special interests or honors.

All Senior Scouts may follow a *service-aide* program, through which they explore possible careers. They receive training from specialists in one or two fields chosen from occupational therapy, child care, library, museum, hospital, office, program (helping an adult Girl Scout leader), or *Ranger* (undertaking a conservation project). They then volunteer to serve in an organization that works in one of these fields. When a girl finishes her *senior-aide* project, she receives a metal bar.

Special Senior Scout groups include *Mariners*, *Trail*



Blazers, and *Wing Scouts*. They follow the five-point and service-aide programs of the Senior Scouts. But they spend much time in special activities. Mariners study how to handle and care for boats. Trail Blazers enjoy camping outdoors. Wing Scouts study aviation.

Special Events. Every year, Girl Scouts of the United States celebrate Girl Scout Week during the week in which March 12, their birthday, falls. On the days of this week, which the Girl Scouts call *The Seven Service Days*, the troops make a special effort to show their communities what Girl Scouts do.

Every three years, Senior Scouts and their leaders hold a camping event called a *roundup*. Thousands of Scouts meet at a special camp site for about two weeks. They live in tents, cook out-of-doors, and enjoy demonstrations of Scout skills and pageantry. Girl Guides from other countries are invited to the roundup.

Uniforms. A Brownie wears a light-brown, belted, cotton broadcloth dress and a brown felt beanie. An Intermediate Scout wears a one-piece belted dress of medium-green cotton covert or broadcloth, with short or long sleeves. She also wears a tie of the troop's chosen color and a dark-green woolen beret with the trefoil emblem. Intermediate Scouts who have reached the seventh grade may wear a uniform consisting of a white blouse, tie, dark-green skirt, and dark-green woolen beret. Senior Scouts wear a short-sleeved, two piece dress of dark-green cotton sharkskin, or a dark-



Paul Parker

Painting a Boat, a Mariner Scout puts her knowledge of boats and boating to good use. Mariners form a special group in Senior Scouting with Rangers, Trail Blazers, and Wing Scouts.

Homemaker

Boating



10. A Girl Scout is clean in thought, word, and deed.



9. A Girl Scout is thrifty.



4. A Girl Scout is a friend to all and a sister to every other Girl Scout.



5. A Girl Scout is courteous.



6. A Girl Scout is a friend to animals.



8. A Girl Scout is cheerful.



7. A Girl Scout obeys orders.

green skirt and white blouse. With these they wear a tie in the color of their special program and a dark-green hat with emblem.

Organization in the United States

Neighborhood Troops. Girl Scouts are organized into local *troops* that vary in size from one neighborhood to another. A troop consists of at least eight girls. Brownie troops have no more than 18 members, and all other troops have no more than 32 members. A volunteer adult leader and one or two adult assistant leaders act as advisers and partners in the troop's activities. Most troops meet once a week for about two hours in a member's home or some community building.

Intermediate and Senior Scout troops may be divided into *patrols* of six to eight girls. Each patrol elects one of its members to be its leader. The patrol leaders, the troop secretary, the troop treasurer, and the adult leader and her assistants form a *Court of Honor*. The court

usually meets before or after every troop meeting and plans the group's future activities.

Some small troops do not have patrols. They use a *club* system of government, and elect an executive committee. Brownie troops generally have fewer than 16 members. An adult leader and her assistants guide their activities. Brownies do not have patrols.

A *troop committee* gives each Girl Scout troop help and advice. The committee includes three to five men and women who live in the community and have an interest in the Scout program. Other adults with special interests and skills may assist the troop as *program consultants*. Churches, schools, and fraternal, business, and civic organizations sometimes sponsor Girl Scout troops.

Councils. More than 1,000 Girl Scout Councils guide the program in local communities or groups of communities. Members of these councils represent the religious, educational, business, civic, and professional groups in each locality. The councils conduct public-relations

GIRL SCOUTS

programs, plan budgets, and raise money for their units.

National Organization. Each Girl Scout Council sends delegates to the National Council of Girl Scouts. It meets every three years to review the Girl Scout program and to elect a board of directors. The directors guide Girl Scout activities between conventions. The Girl Scouts has headquarters at 830 Third Avenue, New York 22, N.Y. Volunteer committees work with a staff of trained professional workers. The Girl Scouts has 12 regions, each with a national branch office and a trained staff to assist the councils and troops.

Every member of the Girl Scouts pays membership dues each year to the national organization. Each member also pays dues to her troop. The whole troop decides what dues members should pay. Troops also work on various money-raising projects which must be approved by local Girl Scout councils. Projects include cookie sales, rummage sales, baby-sitting, catering, and selling old newspapers and rags. The national organization earns money by selling Scout uniforms, insignia, and equipment. Donations also finance Scout projects.

The Girl Scouts publishes *The American Girl*, a monthly magazine dedicated to the interests of Girl Scouts. The magazine for adult leaders, *Girl Scout Leader*, is published monthly from October through June. The Girl Scouts also publishes books that help girls with their programs, such as the *Girl Scout Handbook*, the *Brownie Scout Handbook*, and *Senior Girl Scouting*.

In Other Countries

The World Association of Girl Guides and Girl Scouts has organizations in 50 countries. National organizations are either *full* or *tenderfoot* members of the World Association. Full members have an organized self-governing national movement. A tenderfoot nation has a central Girl Scout movement, but it is not as fully developed. More than 4,000,000 girls and adult leaders belong to the World Association.

The World Association has three homes of its own. It opened *Our Chalet* in Switzerland in 1932, *Our Ark* in England in 1939, and *Our Cabaña* in Mexico in 1957. *Our Cabaña* and *Our Chalet* hold annual Juliette Low sessions when girls from several countries live together for two weeks. *Our Ark* is a hostel where visiting Girl Scouts and Girl Guides may stay while in London.

History

Sir Robert Baden-Powell, a British Army officer, founded the Boy Scouts in 1907 to give boys training in citizenship. Many girls wanted to belong to a similar group, so he helped work out the principles for a separate organization. The Girl Guides program began in 1909 with Sir Robert's sister, Agnes Baden-Powell, as president. The movement spread quickly to other lands. St. Catherine's, Ont., had a Girl Guide program in 1910.

Mrs. Juliette Gordon Low of Savannah, Ga., became interested in the movement when she met Sir Robert in England in 1910 or 1911. She believed that an international Scout program would help promote world peace. She founded the first troop of Girl Guides in the United States at Savannah in 1912. The organization changed its name to *Girl Scouts* in 1913, and opened its first national headquarters in Washington, D.C. Mrs.

Low became the first president. The national organization was incorporated in 1915.

The Brownie movement began in Great Britain in 1915. The next year, Mrs. Carl Derrett, of Marblehead Neck, Mass., founded the first Brownie troop in the United States. In 1920, Olave Baden-Powell, wife of the founder and World Chief Guide of the World Association, called the first international conference of Girl Guides. Members from 14 countries met in Great Britain.

Girl Scouts and Girl Guides in all parts of the world celebrate "Thinking Day" each year on February 22, the birthday of both Sir Robert and Lady Baden-Powell. Girls send messages to one another, and think of what Scouting means. An international exchange program began in 1946. It helps Girl Scout or Girl Guide groups or individuals in various countries who want to visit each other. The Juliette Low World Friendship Fund helps finance some of these visits.

In 1950, Congress issued the Girl Scouts a charter in tribute to its service. In 1957, Girl Scouts and Girl Guides celebrated the hundredth anniversary of Sir Robert's birth. They attended camps in Canada, Great Britain, the Philippines, and Switzerland.

Today, the Girl Scouts has 163,000 troops in neighborhoods throughout the United States and its territories. Each troop dedicates itself to developing girls into happy, healthful citizens.

Critically reviewed by GIRL SCOUTS OF THE U.S.A.

Related Articles in WORLD BOOK include:

PROGRAM ACTIVITIES

Agriculture	Folk Music	Literature
Art and the Arts	Game	Nature Study
Aviation	Handicraft	Safety
Boats and Boating	Health	Sailing
Camping	Hiking	Sewing
Character Education	Hobby	Sports and
Citizenship	Homemaking	Sports-
Community	Human Relations	manship
Conservation	Interior	Theater
Drama	Decoration	Water Sports
Folk Dancing		

UNCLASSIFIED

Baden-Powell, Lord	Georgia (color map,
Boy Scouts	Historic Georgia)
Camp Fire Girls	Low, Juliette Gordon

Outline

- I. What Girl Scouts Do
 - A. Brownies
 - B. Intermediate Scouts
 - C. Senior Scouts
 - D. Special Events
 - E. Uniforms
- II. Organization in the United States
 - A. Neighborhood Troops
 - B. Councils
 - C. National Organization
- III. In Other Countries
- IV. History

Questions

- What is a *Fly-up* ceremony?
- How did the Brownies get their name?
- What is the purpose of the service-aide program?
- What is the *Court of Honor*?
- What is a *patrol*? A *troop*? The National Council?
- What are the Girl Scout Laws?
- How does a girl achieve the *Curved Bar* rank?
- How does a Scout earn a *proficiency badge*?
- What are some ways that Scouts help their communities?
- What does the Girl Scout *trefoil* symbolize?

GIRLS CLUBS OF AMERICA, INC., is a federation of girls' clubs in the United States and Canada. Its programs are planned for girls from 6 through 19 years of age. The programs include cultural, health, and recreational activities carried on after school hours and on weekends in clubhouses especially designed for girls. They aim to develop good citizens and skilled homemakers. The activities are on a daily basis. Many clubs also have day and overnight camps.

The first Girls Club was organized in 1864, in Waterbury, Conn. Nineteen Girls Clubs in six states organized the Girls Clubs of America, Inc., in 1945. Many of the clubs are started by such service organizations as Kiwanis International and Lions International. Other clubs are sponsored and supported by communities.

Girls Clubs of America has more than 56,000 members organized into more than 90 separate clubs. More than 5,000 adults assist in operating the programs. National headquarters are at 22 E. 38th St., New York 16, N.Y. Critically reviewed by GIRLS CLUBS OF AMERICA, INC.

GIRLS' FRIENDLY SOCIETY is an organization for girls and women. It is sponsored by the Episcopal Church, but girls and women of all creeds may join. The society's aim is to develop Christian character and leadership. Its 900 local branches have about 26,000 members. The national headquarters are at 345 E. 46th St., New York City.

GIRLS STATE is a program for training girls in democratic leadership sponsored by the American Legion Auxiliary. Girls who have completed their third year in high school take part in state-wide training courses called *Girls States*. The girls practice operating the machinery of democratic government. They hold political party conventions and nominate candidates for state office. They wage political campaigns and hold elections. The winners are installed in office. Legislative, executive, and judicial branches of these miniature state governments carry out their work.

Girls States are usually held on college campuses for one week in June or July. Girls who attend are selected for potential leadership ability. Activities are directed and counseled by Auxiliary members and college faculty members. State officials give lectures during visits by the girls to state capitols.

Each Girls State selects two girls to attend *Girls Nation*, held every year in Washington, D.C., for the study and practice of national government.

In 1937, the national convention of the Legion Auxiliary first proposed the establishment of Girls States. They were modeled after the Boys States conducted by the American Legion. The first week-long Girls States were held in Kansas and Nebraska in 1939. Headquarters are at 700 N. Pennsylvania St., Indianapolis 6, Ind.

HAROLD D. ROBINSON

See also AMERICAN LEGION AUXILIARY.

GIRONDIST, *jih* **RAHN** *dist*, was a member of a certain political party that grew up during the French Revolution. The name came from the fact that some of the prominent leaders were deputies from a district called the Gironde. The Girondists were republicans who were inspired by the example that had been set by the new United States government. They favored doing away with the monarchy in France and establishing a federal republic. What they feared most of all was that Paris would dominate France. Two of the important Giron-

dist leaders were Jacques-Pierre Brissot de Warville and Madame Marie Jeanne Roland de la Platière.

In the Legislative Assembly (1791-1792), the Girondists were the more radical party. In June, 1793, the Jacobins (republicans who favored the dominance of Paris) led a mob that expelled the Girondists from the National Convention. The Girondist chiefs were guillotined during the Reign of Terror.

J. SALWYN SCHAPIRO

See also FRENCH REVOLUTION; JACOBIN; ROLAND DE LA PLATIÈRE, MARIE JEANNE; CORDAY, CHARLOTTE.

GIRTY, SIMON (1741-1818), was an American pioneer. He was the son of European parents, but was an American Indian by training, sentiment, and choice. The Girty family was captured by Indians when Simon was 15, and he learned Indian languages and customs. He spent three years with the Indians, and then worked as an interpreter around Fort Pitt,

Pa., until 1774. Soon after the American colonies declared their independence in 1776, Girty sided with the British. He led many Indian raids on the colonies.

After the Revolutionary War, he helped the Indians try to stop pioneers moving west. His name struck terror into frontier families, but sometimes he persuaded the Indians to spare the lives of people they captured. One of the men whose lives he saved was Simon Kenton, a famous American frontiersman.



Brown Bros.

Simon Girty helped the British during the Revolution.

When the British gave up Detroit in 1796, Girty fled to Canada, where he spent his last years with Indian friends. He was born near Harrisburg, Pa. FRANK GOODWYN

GISH is the family name of two famous stage, motion-picture, and television actresses.

Lillian Gish (1896-) and her sister, **Dorothy Gish** (1898-), were both born in Ohio. Their parents had little money, and the girls started their stage careers when Dorothy was four and Lillian was six. In 1912, they began making motion pictures, and were featured in many, including *Orphans of the Storm* and *Hearts of the World*.

Lillian Gish

Brown Bros.



Dorothy Gish

Brown Bros.



GISSING, GEORGE R.

Lillian, a great beauty, became known as "the first lady" of silent motion pictures. She starred in the first modern feature motion picture, *The Birth of a Nation* (1915).

Both Lillian and Dorothy returned to the stage when talking pictures were introduced. Dorothy starred as Mrs. Holmes in *The Magnificent Yankee* (1945), and Lillian played Ophelia in John Gielgud's production of *Hamlet* (1936). Both sisters played the part of Mother in *Life with Father* (1939).

NARDI REEDER CAMPION

GISSING, GEORGE ROBERT (1857-1903), was a British novelist. He lived in poor quarters in London, studying, teaching, and writing novels. The life of the poor distressed him, and, although his novels contain humor, they also contain much bitterness. They include *Workers in the Dawn* (1880), *The Nether World* (1889), and *New Grub Street* (1891). *The Private Papers of Henry Ryecroft* (1903) is partly autobiographical. Gissing was born at Wakefield, and taught and traveled in the United States and Germany.

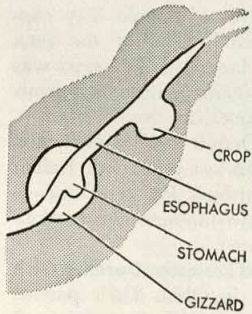
WALTER WRIGHT

GIST, CHRISTOPHER (1706?-1759), was a frontier guide and a friend of George Washington. He was the first to survey the Ohio River Valley (1751). As captain of a company of scouts, he fought under General Edward Braddock at Fort Duquesne (1755), during the French and Indian Wars. Later, he became an Indian agent in eastern Tennessee. Gist was born in Maryland.

GIZA, EL, or GIZEH, EL. See PYRAMIDS.

GIZZARD, GIZZARD, is a special organ of the digestive system of birds and a few other animals. It breaks

up and grinds hard, solid foods. The gizzard in birds is a muscular part of the stomach, and is lined with a thick, tough membrane. It contains stones and gravel that the bird has swallowed. Food enters a pouch of the gullet called the *crop*, and is moistened there. It passes from the crop to the glandular part of the stomach, where it is mixed with gastric juices. The food then passes into the gizzard, where it is



The Gizzard

crushed by the movements of the muscular walls and the gravel. Gizzards of grain-eating birds are better developed than those of insect-eating birds.

L. B. AREY

GJELLERUP, GEHL uh roop, KARL (1857-1919), a Danish author, shared the 1917 Nobel prize for literature. In his first book, *An Idealist* (1878), he broke with Christianity. Among his most influential novels were *The Teutons' Apprentice* (1882), a tribute to Germany; *The Mill* (1896), a story of crime and punishment; and *The Pilgrim Kamanita* (1896). In his last novel, *The Golden Bough* (1917), he returned to Christianity. Gjellerup was born in Robolte.

EINAR I. HAUGEN

GLACIAL EPOCH was a period when glaciers covered much of the earth, as in the Ice Age. See ICE AGE.

GLACIATION is the scoring, erosion, and other effects of the movement of glaciers on the earth's surface. See GLACIER; ICE AGE.



U.S. Forest Service

GLACIER, GLAY shur. Imagine a great river, perhaps many miles long, stretching from near the top of a high mountain down through the valley below. It is a river not of rushing, sparkling water, but of ice. That is a *valley glacier*. The movement of a glacier is so slow that it is measured in inches a day rather than miles an hour.

Kinds of Glaciers. The largest glaciers are termed *continental glaciers*. They cover plateaus or mountain regions, burying the entire landscape except for the highest peaks. Largest of all the icecaps is the Antarctic, in the South Polar region. It covers an area larger than the United States, and is 8,000 feet thick at the South Pole. No people live here, and much of the area is unexplored. Next largest is the Greenland Icecap, a lonely, storm-swept waste of 600,000 square miles. Smaller icecaps are found especially in Norway and Iceland. Glaciers which occupy mountain valleys are termed *valley glaciers*. These are familiar in the Alps and the mountains of the western United States. Valley glaciers which emerge from their valleys and spread widely on a plain outside the mountains are termed *piedmont glaciers*. These are relatively rare but are often found in Alaska, where the Malaspina Glacier is a splendid example.

How Glaciers Form. A part of all snow, no matter how cold the climate, will evaporate in the sun. If the climate is warm enough, some will melt and flow away in rivers. But where a great deal of snow piles up on a mountainside, eventually the weight of the snow will force it to move downhill. That is how a glacier starts. The glacier moves slowly down the valley. As the temperature rises, more and more snow melts or evaporates. In time, the snow melts faster than the glacier advances. Here the glacier stops and a river begins, if the glacier is on land. Sometimes a glacier reaches the sea and great chunks of the glacier, many of which weigh thousands of tons, are icebergs.

Structure. The ice which makes up a glacier is solidly packed snow. After snow has lain on the ground for some time, the flakes lose their form and join together in

◀ **A Rocky Mountain Glacier** consists of a stream of ice that moves slowly but steadily downward along the valleys between mountain peaks.

A Huge Alaskan Glacier towers above the water and forms a natural barrier along the shore. Large chunks may break off and form icebergs. ▶

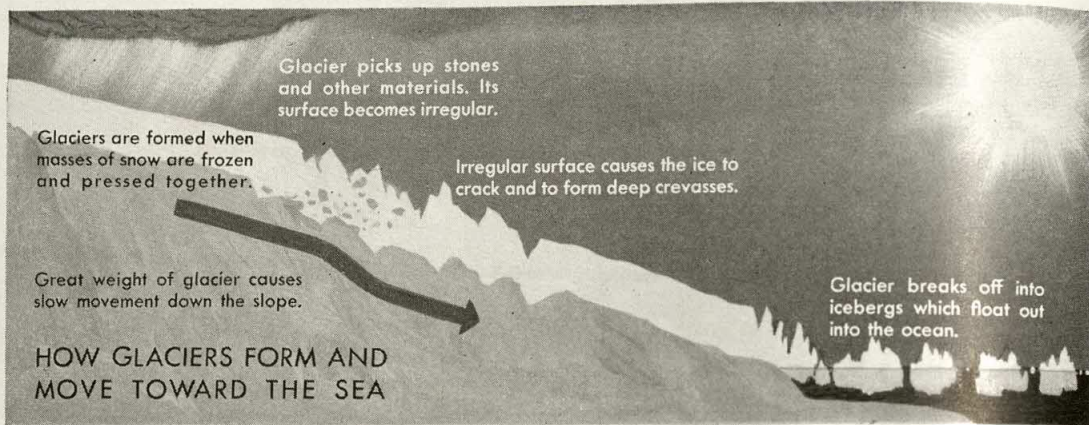
▼ **Aerial View of a Glacier** shows how the branches of a glacier flow together like the tributaries of a river. This glacier is near Juneau, Alaska.



Pan American

Dept. of Defense





grains. We see snow like this when drifts finally melt in the spring. On the mountains where snow remains from year to year it becomes a spongelike, or porous, ice, which is called *firn*, or *névé*. Each year, as new layers of snow are added, the lower layers are pressed more and more and become harder and harder. Finally the

Mer de Glace, or Sea of Ice, a glacier on Mont Blanc, is near Chamonix, France. It is one of Europe's great natural wonders.

De Cou, Ewing Galloway



lower layers become as hard as ordinary ice. Glaciers which form great oval-shaped masses are called *drumlins*. Ridges formed by streams flowing under the ice are termed *eskers*.

Glaciers sometimes pass over irregularities in their path. These may cause cracks, or *crevasses*, in the ice. Some crevasses fill with light snow, and are hard to see. They are very dangerous for mountain climbers. Sometimes crevasses close up, but usually their edges melt and they widen at the top.

The surface of a glacier becomes very uneven as it moves along. This roughness is due to crevasses, and to stones the glacier picks up.

The lower end of a glacier is sometimes very steep. From under it comes a stream of ice-cold water, formed by the melting of the glacial ice. Many rivers begin as such streams.

Movement. A glacier moves down a valley much as a mass of almost solid tar would move down a slope. The upper and middle parts move the fastest. The sides and bottom are slowed as they rub against the sides and bottom of the valley. The speed of the glacier can be measured by the movement of an object on its surface. The speed of most glaciers ranges from several inches to several feet a day. Some glaciers in Alaska and Greenland move fifty to sixty feet a day in summer. In summer, the end of the glacier may be melted back upslope. It may also stay in about the same place throughout the entire year, depending on how fast the ice melts.

Moraines. Like an enormous broom, a glacier sweeps up rocks and other material in its path. This debris is usually piled up in narrow ridges, called *moraines*, through the mass of the glacier. These ridges near the sides are called *lateral moraines*. Those near the center are *medial moraines*. The debris piled up at the glacier's end is called a *terminal moraine*.

Erosion. Because a glacier sweeps before it all the loose material in its path, it tends to deepen the valley through which it passes. It removes all dirt and lays bare the rocks. It polishes the rocks and marks them with scratches, or *striae*. This process is called *erosion*. During the ice age thousands of years ago, glaciers covered large parts of Europe, Asia, and North America. The action of the glaciers on the land over which they passed greatly changed the appearance of the land. Steep recesses called *cirques* are sometimes carved in the sides of mountains.

Famous Glaciers. The best-known glaciers are those in the Alps in Europe and in the mountains of northwestern North America. Glaciers that are found in the Alps are small compared with the glaciers of Alaska. The largest Alaskan glaciers are found on the shores of Glacier Bay, around Mount Fairweather, and near Cook Inlet. The Malaspina, on Yakutat Bay, Alaska, is 1,550 feet high and has an area of 1,500 square miles. The Valdez, on Prince William Sound, is fifteen miles long. The Muir is 200 feet high and extends three miles along the shore of Glacier Bay. Many of the valleys of the Alaskan coast are filled with ice rivers. The deep cuts in the coast, called *fiords*, were made by the action of glaciers.

The glaciers which are easiest for Americans to reach and study are those in Glacier National Park, in Montana, and in Banff National Park, in Canada. Large glaciers are also found in the Selkirk Mountains in British Columbia, along the Canadian Pacific Railway.

The Mer de Glace, or *Sea of Ice*, on Mont Blanc, and the glaciers on Mont Rosa are the best known in Europe. There are also glaciers in the mountains of Scandinavia, in the Andes in South America, and in the Himalayas in Asia. Others are found in Greenland and on other islands in the Arctic, as well as on the Southern Alps of New Zealand. In fact, glaciers occur wherever there is enough snow and cold weather to permit them to form. There are enough glaciers to encase the earth in a layer of ice 100 feet thick.

ELDRÉD D. WILSON

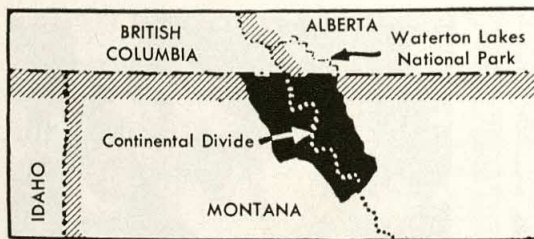
Related Articles in WORLD BOOK include:

Alaska (Glaciers)	Geology (Glaciers Change the Land)
Alps	Glacier National Park
Canada (picture, Glistening Glaciers)	Ice Age
Crevasse	Iceberg
Erosion	Kettle Hole
Fiord	Moraine

GLACIER BAY NATIONAL MONUMENT is in southeastern Alaska. The 2,274,595-acre monument was established in 1925. It contains massive tidewater glaciers and exhibits of early stages of postglacial forests. One of the attractions is the famous Muir Glacier, which is nearly two miles wide.

GLACIER NATIONAL PARK lies in northern Montana on the boundary between the United States and Canada. Part of the Rocky Mountain chain, called the *Great or Continental, Divide*, runs north and south through the center of the park (see CONTINENTAL DIVIDE). Glacier National Park covers 1,013,129.12 acres, and was once part of the Blackfoot Indian Reservation. In 1910 it was set aside by Congress as a national park. It is open to tourists only during the summer months. A Canadian preserve, Waterton Lakes National Park, lies just north of Glacier National Park. In May, 1932, the two parks were united by the United States and Canadian governments. Together they are called the Waterton-Glacier International Peace Park, although they are under separate administrations. For location, see MONTANA (color map).

Glaciers. The park was named for the 60 glaciers found here. These beds of ice were once part of a huge ice sheet that covered this area. Some of the glaciers are only a few acres in size, but others cover much larger areas. Blackfoot Glacier, the largest in the park, covers about three square miles. It lies about 8,000 feet above sea level on the north slopes of Mount Jackson and



Location Map of Glacier National Park (in black)

Blackfoot Mountain. The Harrison and Pumpelly glaciers cover the south slopes of Jackson and Blackfoot.

Mountains. Glacier National Park is also noted for its beautiful mountains, whose peaks form picturelike designs. The summits of some of these mountains have never been reached by man. The highest peak in the area is Mount Cleveland (10,438 feet), which lies in the northern part of the park. Other mountains higher than 10,000 feet include Kintla Peak, Mount Siyeh, and Stimson Mountain.

Lewis Overthrust is a high ridge visited by thousands of tourists in Glacier National Park. Colorful layers of rock may be seen along the sides of the ridge, much like the layers found in the Grand Canyon of Arizona. This overthrust was made in ancient times when a disturbance inside the earth caused the earth's surface to crack like a squeezed orange. One area was pushed, or thrust, up and over another area.

Lakes. The park has about 250 lakes. Some lie high in the mountains, and others nestle deep in the valleys. One of the most beautiful of these lakes is the Upper Saint Mary. It is about 10 miles long and is completely surrounded by mountains, except at the point where it meets the Saint Mary River. Lake McDonald, the largest in the park, measures 11 miles long and has an average width of one and a half miles. Swiftcurrent Lake is one of the smallest lakes in the park, but is also one of the most famous, because it lies in the heart of a region of great beauty. Iceberg Lake, only half a mile long, lies on such high ground (6,000 feet) that even on warm summer days there are icebergs floating in its waters.

Animal Life in Glacier National Park is protected by law, and hunting is never allowed. Among the wildlife found here are Rocky Mountain goat and sheep, bear, moose, elk, deer, coyote, wolves, and lynx. Game birds, such as geese and ducks, nest in the park. The streams are abundant with fish, especially eastern brook, rainbow, and cutthroat trout. HERBERT E. KAHLER

See also CANADA (National Parks); GLACIER; MONTANA (color picture).

GLACKENS, WILLIAM JAMES (1870-1938), an American painter and illustrator, was an original member of the Ashcan movement and "The Eight." Both groups rebelled against traditional American subjects and painted scenes of city streets, parks, and playgrounds. Later, Glackens was influenced by the Impressionists, especially Pierre Auguste Renoir. He chose different subjects, and painted portraits and nudes in bright, luminous colors.

Glackens was born in Philadelphia and studied at the Pennsylvania Academy of Fine Arts and in Paris. He worked as an illustrator for newspapers and for several



Art Institute of Chicago

Realism marked much of William J. Glackens' work. He painted *Chez Mouquin*, a New York City cafe scene, in 1905.

national magazines, including *Scribner's* magazine and *The Saturday Evening Post*. Although Glackens was active in the revolt against academic art, he was elected to the National Academy of Design in 1933. MILTON W. BROWN

GLADIATOR, *GLAD ih AY ter*, was one of the trained warriors who took part in bloody exhibitions of fighting in ancient Rome. The name comes from the Latin word *gladius*, which means sword. But gladiators used many different kinds of weapons. Most gladiators were slaves, but some freemen also became gladiators, either for money or fame.

The first recorded gladiatorial show was held in 264 B.C., to celebrate the funeral of the father of Marcus and Decimus Brutus. Such shows steadily grew more popular. Candidates for public office competed with one another to put on the biggest gladiatorial exhibition. Shows also were put on at public expense. It is said that an exhibition given by the Emperor Trajan lasted over 100 days, during which 2,000 men fought to the death. But many people objected to the cruel shows. Theodoric ended the contests in A.D. 500.

When a gladiator was overcome, it was usually up to the spectators to decide whether his life should be spared. He could ask for his life by a gesture, and the people in return signaled whether he could live or should die. Professional gladiators sometimes tried to win the favor of the audience without seriously hurting each other. They staged carefully practiced exhibitions of great ferocity, somewhat like present-day wrestling matches. By this method a gladiator could sometimes live a comfortable, exciting, and reasonably long life. Slaves who became successful gladiators were sometimes given their freedom, and the victors in these

contests often were given valuable gifts and awards.

One of the most famous gladiators of history was Spartacus, a Thracian slave, who led a great rebellion of gladiators and other slaves. His armies met and defeated some of the best troops of Rome. His revolt was finally put down in a struggle called the War of the Gladiators (73-71 B.C.).

WILLIAM SCOTT FERGUSON

See also **COLOSSEUM**; **ROMAN EMPIRE** (picture, At the Colosseum); **SPARTACUS**.

GLADIOLUS, *glad ih OH lus* or *gluh DI oh lus*, is a garden plant with spikes of large silky flowers that are popular in vases and displays. It is also called *sword lily*. Many gladioli are grown in America and Europe.

The flowers are of many different colors, through all the shades of red and orange to white. There is even a blue gladiolus, which comes mainly from South Africa. The tube-shaped flowers grow above one another in long clusters along one side of the stem. The lower blossoms open first. If a spike of gladiolus is cut when the lower flowers are the only ones in bloom, the buds above them will open one after another.

Gladioli have tall, slender stems like an iris, and long sword-shaped leaves. Their name is the Latin word for *little dagger*. They grow from *corms*, or solid bulbs, which form new corms above the old ones. Each fall the corms should be dug out of the garden and stored indoors. They grow well when they have a rich, soft soil, sunlight and plenty of water. The gladiolus thrips, a tiny insect, feeds upon gladioli.

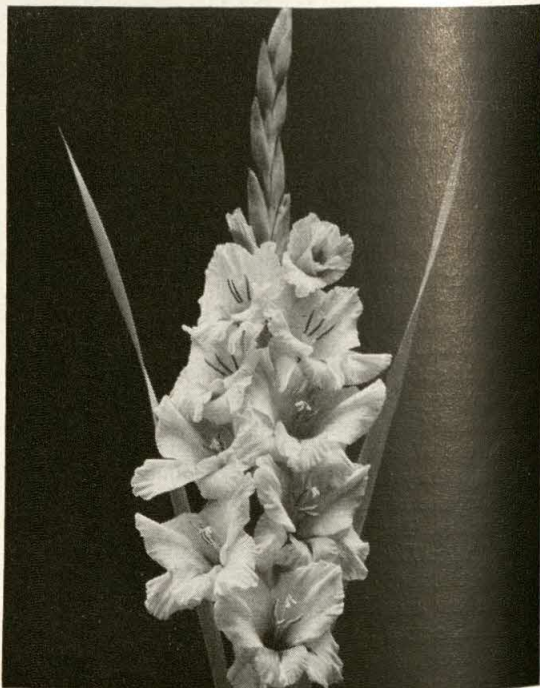
Scientific Classification. Gladioli are in the family *Iridaceae*. They are genus *Gladiolus*. A common kind is genus *Gladiolus*, species *communis*.

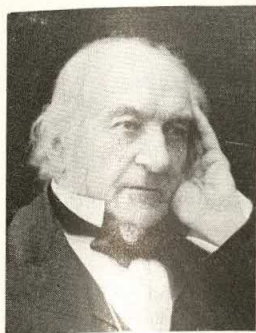
ALFRED C. HOTTES

See also **BULB**; **FLOWER** (color picture, Summer Garden Flowers); **THRIPS**.

A Blooming Spike of Gladiolus. The gladiolus is a popular flower because it is easy to grow and lasts well after cutting.

W. Atlee Burpee





Chicago Historical Society

William E. Gladstone

GLADSTONE, WILLIAM

EWART (1809-1898), was one of the most famous British political leaders of the 1800's. He was an outstanding lay leader of the Church of England, and wrote several books on theology.

Elected to the House of Commons in 1833 as a Conservative, he became a follower of Sir Robert Peel. During the argument over repeal of the Corn Laws in 1846, Gladstone

gradually switched to the Liberal party (see **CORN LAWS**; **PEEL, SIR ROBERT**). He served in mixed-party and Liberal cabinets as Chancellor of the Exchequer, and became famous for his budgets, which lowered income taxes and abolished many import duties.

By 1865, he had the reputation of an orator, a skilled financier, and a staunch liberal. In that year, he was named leader of the Liberal party in the House of Commons. He helped amend the Conservative government's Reform Bill of 1867 so that it doubled the number of those able to vote in national elections. In 1868, he began his first term as prime minister.

Prime Minister, 1868-1874. During Gladstone's six years as prime minister, several important laws were passed. He was determined to correct abuses in the administration of Ireland. He made the Church of England in Ireland a voluntary organization, and took about half of its great wealth from it. He also pushed through legislation that made it harder to evict Irish tenants from the lands they rented. Another important act gave England, for the first time, a system of elementary schools open to all children (1870).

When the Conservatives, under Benjamin Disraeli, came back to power in 1874, Gladstone resigned the leadership of the Liberal party. But he rushed back into politics when the Conservatives' foreign and colonial policy outraged his moral sense (see **DISRAELI, BENJAMIN**). Gladstone preferred conciliation to war in international disputes.

The Fight Over Irish Home Rule. Gladstone's second term as prime minister, from 1880 to 1885, produced less important legislation than the earlier period. In 1884, parliament passed another reform bill, which brought Great Britain closer to universal manhood suffrage. In 1886, Gladstone's third term as prime minister ended quickly when he tried to give the Irish a larger measure of self-government. His Home Rule Bill was defeated in the House of Commons, and resulted in a permanent split in the Liberal party.

In 1892, at the age of 83, Gladstone again became prime minister. He made a final attempt to win home rule for Ireland. This time, his Home Rule Bill got through the House of Commons only to be defeated overwhelmingly in the House of Lords. Crushed and overwhelmingly in the House of Lords. Crushed and worn out by long service, he retired from office in 1894.

Gladstone was born in Liverpool, and studied at Eton College and Oxford University.

JAMES L. GODFREY

See also **GREAT COMMONER**; **LIBERAL PARTY**; **VICTORIA**.

GLAND

GLAND is an organ of the body that manufactures and secretes needed substances. There are two important kinds of glands, exocrine and endocrine. *Exocrine glands* discharge their products through *ducts*, or tubes, either into the intestines or outside the body. Therefore, they are sometimes called glands of *external secretion*. The exocrine glands include the *salivary* glands, the *mucus* glands, the *tear* glands, the *pancreas* (which is also an endocrine gland), the *liver*, and the *sweat* glands. Also included are the *mammary* glands, that produce milk; the *sebaceous* glands, that produce an oil; and the glands in the stomach and intestines that produce substances necessary for the digestion of food.

Endocrine glands make and release their products directly into the blood stream. They are often called *ductless* glands or glands of *internal secretion*. The substances they produce are called *hormones*. Tiny quantities of these hormones have powerful effects on the body. They affect growth, the shape of the body, and the way in which the body uses food. And, perhaps most important, they allow the body to make the proper adjustments to changes in the outside world.

The activity of the endocrine glands is carefully balanced. If a gland should become either too active or not active enough, illness results. For good health and development, the glands must work together as a unit.

The Endocrine Glands

Each type of endocrine gland produces one or more hormones. The activity of the gland is controlled so that the proper amount of hormone is released at the proper time. The *pituitary* gland, which acts as a regulator, carries out much of this control. The pituitary gland itself is attached to a part of the underside of the brain, called the *hypothalamus*. The hypothalamus serves as a meeting point where the activities of the endocrine system are coordinated with the activities of the nervous system. In this way they regulate body development and maintain good health.

The Pituitary Gland looks like a cherry dangling from the base of the brain. The gland is made up of three *lobes*, or parts. The *posterior*, or rear, lobe stores and releases two hormones, oxytocin and antidiuretic hormone. *Oxytocin* helps in the delivery of a baby and in the release of milk from the mammary glands. *Antidiuretic hormone*, also known as *vasopressin*, is necessary to prevent the loss of excess water from the kidneys. In the absence of this hormone, great amounts of water are lost in the urine. This results in a disease called *diabetes insipidus*. The *intermediate*, or middle, lobe of the pituitary secretes *melanocyte-stimulating hormone*, sometimes called *intermedin*, which deepens the pigment of the skin.

The *anterior*, or front, lobe of the pituitary produces many different hormones. Some of these control the activity of other endocrine glands. For this reason, the pituitary has been called the "master gland" and the glands it controls, "target glands." *Gonadotropins* regulate the development and function of the sex glands; *thyrotropin* regulates the activity of the thyroid gland; and *adrenocorticotrophic hormone* (ACTH) controls the functioning of the adrenal cortex. *Somatotropin*, or growth hormone, regulates the growth of the whole body.

GLAND

Prolactin stimulates the mammary glands to produce milk.

The Hypothalamus must be considered an endocrine organ even though it is part of the base of the brain itself. Clusters of nerve cells, called *nuclei*, in the hypothalamus produce hormones. These hormones pass through veins into the anterior pituitary gland. There they stimulate the anterior pituitary gland to secrete gonadotropin, thyrotropin, and adrenocorticotropin when these substances are needed by the body.

The Pineal Gland is located in the upper rear portion, and between the halves, of the brain. Scientists still do not completely understand all the functions of the pineal gland. But in 1958 researchers isolated a substance secreted by the pineal gland. They named it *melatonin*.

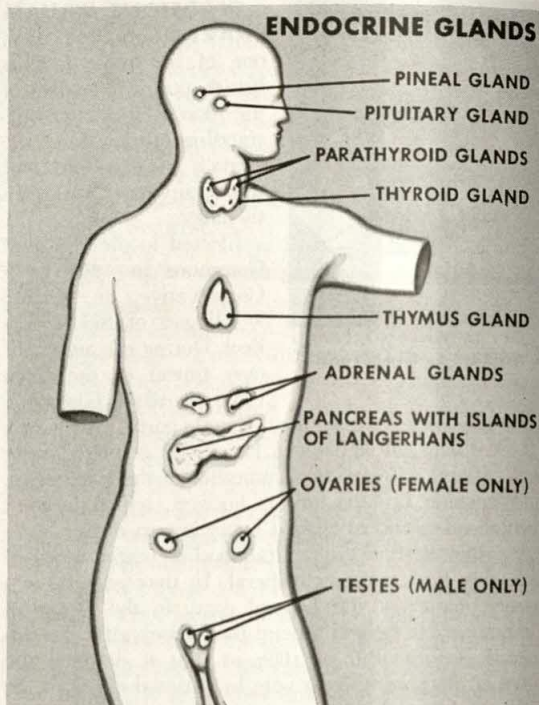
The Thyroid Gland consists of two lobes that lie alongside the windpipe in the neck. They are joined by a narrow band of tissue that passes in front of the windpipe. Thyroid hormones regulate *metabolism*, the rate at which the body uses oxygen and food.

The Parathyroid Glands are four tiny bodies located on the back surface of the thyroid gland. They produce a hormone called *parathormone*, which regulates the way the body uses calcium and phosphorus. If not enough of this hormone is produced, the concentration of calcium in the blood falls and the amount of phosphorus rises. As a result, the muscles begin to twitch uncontrollably and convulsions may occur. To prevent these symptoms, doctors may give a patient parathormone, calcium, and vitamin D.

The Thymus Gland is made up of spongy tissue and lies in the chest cavity behind the breastbone and just above the heart. No one has learned exactly what the function of the thymus gland is or what hormones it produces.

The Pancreas is included among the endocrine glands, because it contains groups of cells called the *islands of Langerhans*. These cells produce two hormones, glucagon and insulin. *Glucagon* acts on the liver, causing it to release stored sugar into the blood stream. *Insulin* helps blood sugar gain entrance to the body cells so that it can be used for energy. When the pancreas produces too little insulin, the body cannot use up enough sugar. Then much of the excess sugar is carried away in the urine. This condition is *diabetes mellitus*, commonly called *diabetes*. To control this disease, doctors often use insulin that is obtained from the pancreatic glands of animals.

The Adrenal Glands are often called the *suprarenals*. There are two of these glands, one above each kidney. Each adrenal gland has two important parts: the *medulla*, or core, and the *cortex*, or outer portion. The medulla forms epinephrine, known also as Adrenalin, and norepinephrine. When people become very angry or frightened, large amounts of these hormones flow into the blood and are carried throughout the body. The hormones then produce changes that would help anyone who was preparing to fight or to run away. The person's heart beats faster and stronger. His blood pressure rises. His bronchial tubes dilate to allow him to breathe more quickly and easily. The pupils of his eyes enlarge to admit more light. In addition, his liver releases more



sugar into his blood stream and his body burns oxygen more rapidly. This provides the person with an extra spurt of energy that he might need for immediate action.

The cortex of the adrenal gland produces a large number of hormones whose chemical structure resembles that of the sex hormones. They are also known as *steroids*. There are three main groups of these hormones. One group acts much like the sex hormones. The second group, including *aldosterone*, regulates the amount of sodium and potassium used by the body. *Cortisone* and *hydrocortisone* are examples of the third group. These substances are needed by the body so that it can adjust to the stresses of living. The adrenal cortical hormones have so many important functions that without them, a person would soon die. Fortunately, these substances are available to doctors who can give them to persons whose bodies lack them.

The Sex Glands are also known as gonads. They contain cells involved in reproduction. They also produce several different hormones, called *steroids*, which affect the functioning of the body. The *ovaries* are the female sex glands. They produce three hormones. Two of them, known as *estrogen* and *progesterone*, make it possible for women to bear children. They are also responsible for the development of the female body. The third ovarian hormone, *relaxin*, helps to relax the tissues of the birth passages, thus making them wider.

The male sex glands are called the *testes*. They produce *testosterone*, the male sex hormone. This substance is responsible for stimulating the development of such male characteristics as the beard and the deep voice.

Hormones of the Stomach and Intestines. Although the stomach and intestines are not usually thought of as glands, they do produce hormones and therefore can be classed with the secretory glands. The stomach produces a hormone called *gastrin*. This substance acts on

EXOCRINE GLANDS

LACHRYMAL GLANDS
(TEAR GLANDS)

SALIVARY GLANDS

MAMMARY GLANDS
(FEMALE ONLY)

LIVER

INTESTINAL GLANDS

BULBO-URETHRAL
GLANDS
(MALE ONLY)

certain cells in the stomach, causing them to secrete acid necessary for digestion. The intestines produce several hormones. One, called *secretin*, stimulates secretion of the gastric juices used in digesting foods. Another, called *serotonin*, is produced by special cells in the intestines. This hormone causes the small blood vessels of the body to contract.

Diseases of Glands

The endocrine glands are all small structures, but the hormones they produce are very important. For this reason, if an endocrine gland is not working properly, disease that affects the entire body results. Fortunately, doctors can treat many of these diseases successfully. For example, if a gland secretes too much hormone, surgeons can remove it. In other cases, if a gland does not produce enough of its hormone, doctors can give the needed hormones to the patient and thus restore him to health.

T. B. SCHWARTZ

Related Articles in WORLD BOOK include:

GLANDS

Adrenal Gland	Pancreas	Prostate Gland
Gall Bladder	Parathyroid Gland	Spleen
Kidney	Pineal Gland	Thymus Gland
Liver	Pituitary Gland	Thyroid Gland
Mammary Glands		

DISEASES OF GLANDS

Addison's Disease	Diabetes	Mongolism
Cretinism	Goiter	

UNCLASSIFIED

ACTH	Intestine	Perspiration
Adrenalin	Lymph	Saliva
Digestion	Metabolism	Secretion
Hormone	Milk	Stomach
Insulin	Mucus	Tears

GLANDERS is a severe disease of horses and mules.

It also occurs in dogs, goats, sheep, and sometimes in man. Cattle seem to be immune to it. Glanders is caused by the rod-shaped bacillus *Actinobacillus mallei*. This bacillus may lodge in almost any organ of the body. It spreads through nasal discharges and breaks in the skin. Glanders causes fever, loss of weight, swollen lymph glands, and pussy nasal discharge. Ulcers form in the lining of the nose and in the lymph nodes.

Infected animals can usually be detected by the *mallein test*. In this test, products of the glanders bacillus are injected into the animal's eye. An inflammation of the eye covering with a pussy discharge occurs in diseased animals. Glanders is especially dangerous when many animals are collected together. Both mild and severe cases spread the disease. There is little immunity. Few infected animals recover, and many may die in a few weeks. *Farcy*, a mild form of glanders, causes ulcers in the skin, but sores may also form in the nose and lungs. Animals with farcy may live for years. D. W. BRUNER

GLASER, DONALD ARTHUR (1926-), an American physicist, won the Nobel prize in physics in 1960 for inventing the bubble chamber. This device is a vital aid in nuclear physics. With it, researchers can track the paths of nuclear particles. It contains liquefied gas. Nuclear particles shot through the liquefied gas leave tracks of tiny bubbles that can be photographed. Glaser was born in Cleveland, Ohio. He taught physics at the universities of Michigan and California.

GLASGOW, GLASS koh (pop. 1,081,700; met. area, 1,600,000; alt. 45 ft.), is the largest city in Scotland and one of the greatest shipbuilding centers in the world. Extensive dredging and construction have made Glasgow a great port. The city's location in the heart of the Scottish coal fields helps to explain its importance in manufacturing. Glasgow gets its water from Loch Katrine. This lake is mentioned in Sir Walter Scott's poem, "The Lady of the Lake." The people of Glasgow are called *Glaswegians*.

Trade and Manufactures. Glasgow lies mainly on the northern bank of the River Clyde, which empties into the Firth of Clyde on the west coast of Scotland. For location, see SCOTLAND (map). The city has miles of excellent docks and a busy harbor.

Glasgow's most important manufactures are ships, iron and steel, metal goods, and textiles. The city exports woolen, linen, and cotton goods, machinery, coal, paper, chemicals, and whisky. It imports metal, wheat, wool, corn, sugar, tobacco, timber, and petroleum.

Description. Glasgow is a modern city, with many wide streets, parks, and attractive buildings. It has a botanical garden and art museum, and several schools of higher learning. There are also ancient buildings which recall Glasgow's long and interesting past. Most famous of all Glasgow's landmarks is its cathedral, which dates from the 1100's. The cathedral has a beautiful underground vault. The University of Glasgow was founded in 1450. It was later endowed by Mary, Queen of Scots, and her son, King James I of England.

In recent years, Glasgow has undertaken a program of city improvement. Old, unsightly structures have been torn down and streets have been widened. Laws have helped reduce the smoke nuisance.

GLASGOW, ELLEN

Government. Glasgow owns its public services, such as streetcar lines and gas works. The various city departments are run by divisions called "trusts." This system of city government was set up by a special act of Parliament. For example, the police trust manages the police force, and the market trust deals with the market needs of the city.

Glasgow's system of city government has been studied by American and Canadian city authorities. Various cities have copied its system of municipal ownership of public utilities.

History. Glasgow's history can be traced back to a church which was built by Saint Kentigern in the 500's. Its name is said to be derived from the Celtic word *Cleschu*, which means *dear green spot*. But the city did not come into existence as a population center until the 1100's. It rose steadily in importance after Scotland and England were united in 1707. In the 1700's, shipments of tobacco from the American colonies made the city an important trading center. The population increased 10 times during the 1800's, when the shipbuilding and iron industries expanded, and attracted more workers.

Glasgow's docks and shipyards were major targets for German air raids during World War II. Many American companies opened branch offices and factories in the Glasgow area in the 1950's.

WILLIAM A. HANCE

GLASGOW, ELLEN (1874-1945), an American author, wrote witty, compassionate novels about upper-class life in the South, a life she knew well. She was born in Richmond, Va., into a wealthy family. Because she was a delicate child, she had little schooling. But she read widely in her father's large library. She struggled silently for intellectual independence. Her family hardly recognized her struggle, and when she finally revealed herself as the author of an anonymous novel, *The Descendant* (1897), they were as surprised as other people.

Miss Glasgow never married, but lived the cultivated life of the upper-class Southerner of her time. Her novels reveal both the conservative social conventions and the often unconventional ideas of this way of living. Her books deal largely with the life of her own class, but her judgments of that life are clear and unrestricted by class conventions.

Like all good novelists of manners, she had too deep an understanding of human nature to have much faith in social reform, although she sympathized with the victims of social injustice. She also had a deadly eye for hypocrisy, wherever it occurred. Her friend and neighbor in Richmond, the writer James Branch Cabell, called her "a grande dame of a rare and almost extinct type" (see **CABELL, JAMES BRANCH**).



Ellen Glasgow

Miss Glasgow's finest novels include *Barren Ground* (1925), *The Romantic Comedians* (1926), *They Stood to Folly* (1929), and *Vein of Iron* (1935). *In*

This Our Life (1941) won a Pulitzer prize. ARTHUR MIZENER

GLASGOW, UNIVERSITY OF, is the second oldest university in Scotland. It has six colleges: arts, law, divinity, medicine, science, and engineering. Degrees are granted from each college. The average enrollment is 5,100, including more than 1,000 women. The university was founded in 1453 by William Turnbull. Many students live in their own homes, but others live in lodgings and hostels.

R. W. MORRIS

GLASPELL, SUSAN (1882-1948), an American author, won a Pulitzer prize in 1931 for her play, *Alison's House*

(1930). Her writings also include the plays *Trifles* (1916) and *The Inheritors* (1921), and the novels *Brook Evans* (1928) and *Ambrose Holt and Family* (1931). With her husband, George Cook, and others she helped organize the Provincetown Players, who first produced Eugene O'Neill's plays. She wrote a biography of her husband, *The Road to the Temple* (1926). She was born in Davenport, Iowa.

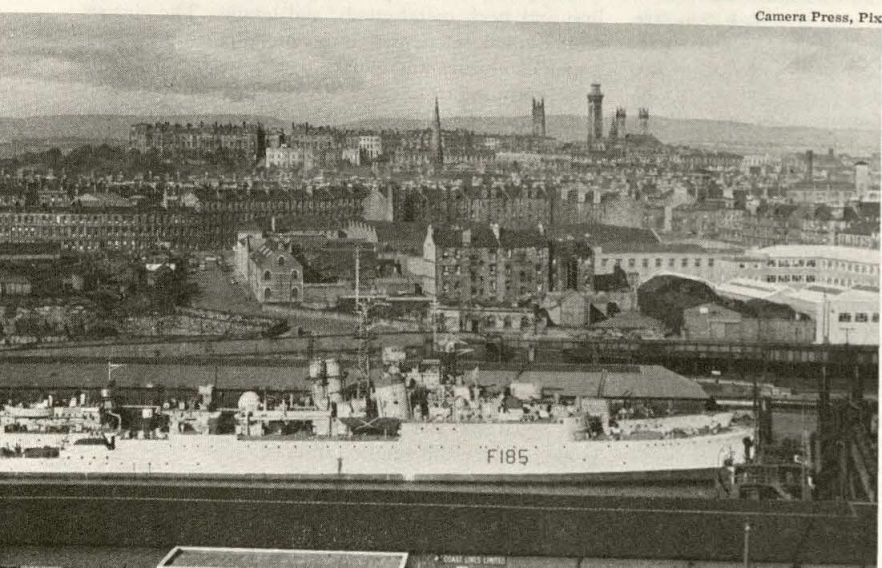
GEORGE FREEDLEY

Susan Glaspell

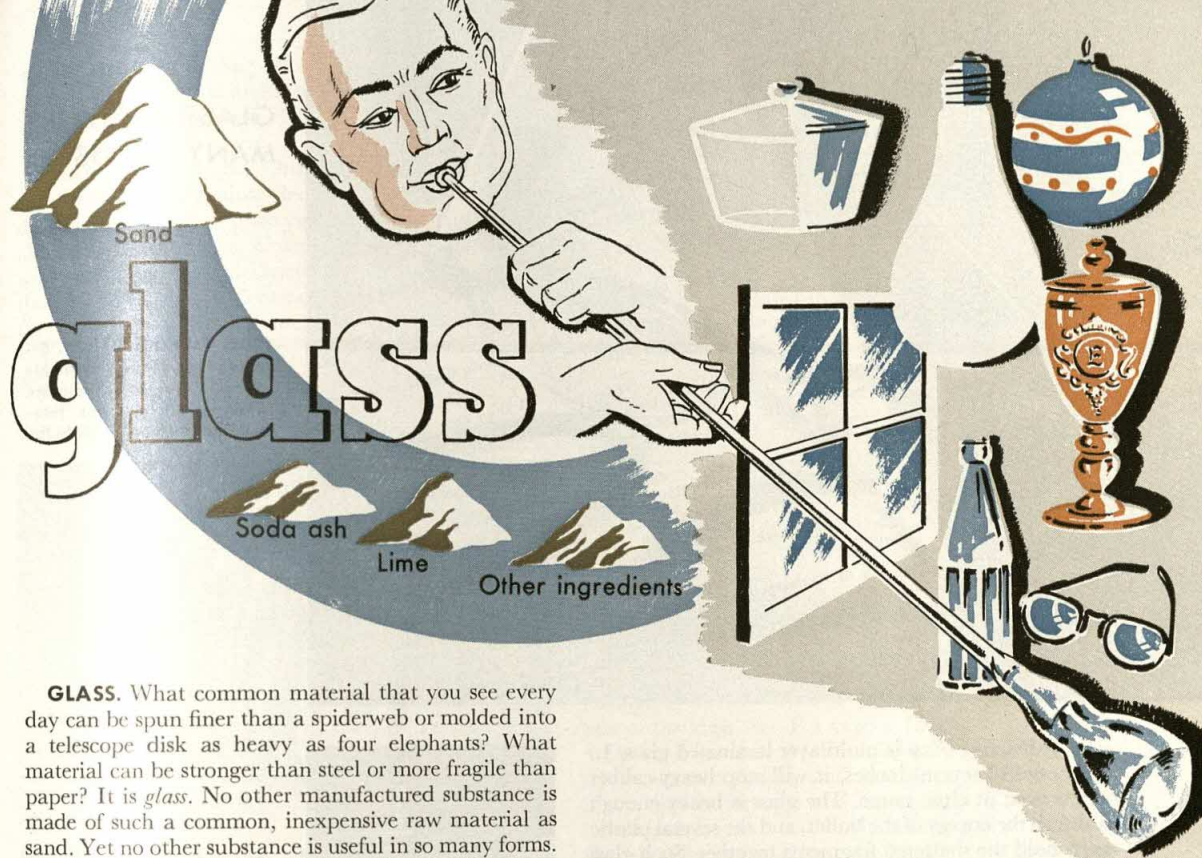
Lippincott



Camera Press, Pix



The Glasgow Shipyards and repair docks line the banks of the River Clyde for miles. The shipbuilding industry produces vessels ranging from flat barges to luxury liners. The spires of Trinity College, part of the University of Glasgow, tower high above the city, background.



GLASS. What common material that you see every day can be spun finer than a spiderweb or molded into a telescope disk as heavy as four elephants? What material can be stronger than steel or more fragile than paper? It is *glass*. No other manufactured substance is made of such a common, inexpensive raw material as sand. Yet no other substance is useful in so many forms. It can be lighter than aluminum or heavier than iron. Glass can be clear, or colored in any hue.

No other material is more important to mankind. Science could not function without glass. Take away the scientist's chemical glassware, his glass thermometer, and the glass lenses in his microscopes and telescopes, and he could not work effectively. Without glass, none of the modern forms of transportation and communication would work. And what could you use as a substitute for glass in an electric-light bulb? Glass is more than useful. It is ornamental, too. Ever since men learned how to make glass, they have used it as an art material. See **GLASSWARE**; **STAINED GLASS**.

Kinds of Glass in Everyday Life

When we speak of glass, ordinarily we mean a transparent, shiny substance that breaks rather easily. We may think of the glass in our windows and the glass used in kitchenware as being the same material. Actually they are not. There are many kinds of glass. One glass company alone, the Corning Glass Works, has developed more than 65,000 kinds of glass.

Flat Glass is familiar to everyone because of its widespread use in windows in buildings, automobiles, ships, and trains. Such windows usually are *glazed*, or filled, with *sheet glass*, so-called *window glass*. Where exceptionally clear and accurate vision is necessary, as in automobile windshields or store display windows, *polished plate glass* is used. Sheet glass is drawn from the melting furnace with a fire-polished surface and is given no additional treatment. Plate glass is sheet glass that has been carefully ground and polished to smooth the surface. Because of more and larger windows in modern

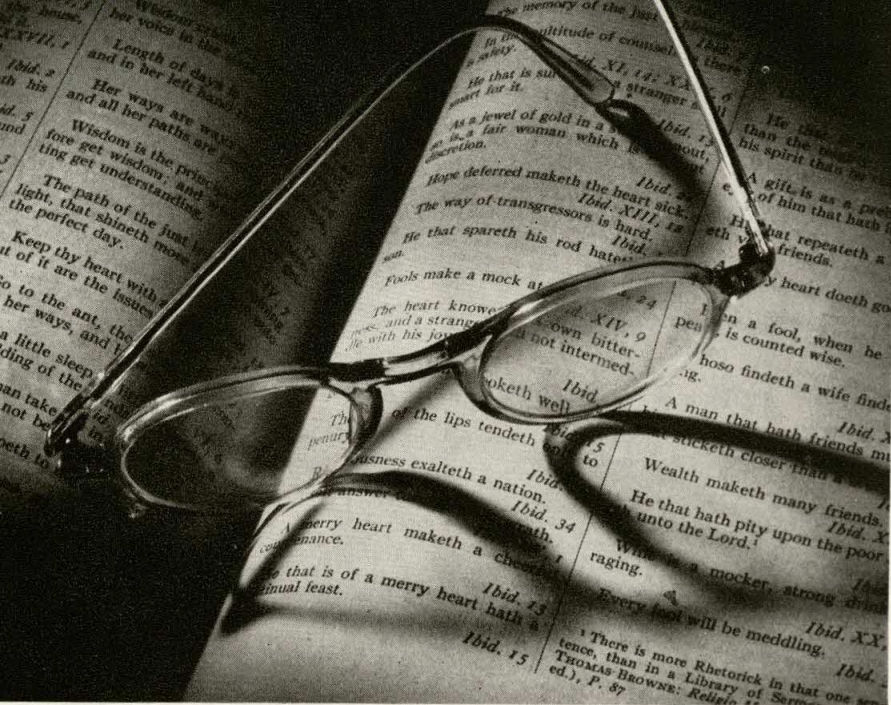
homes, the use of flat glass has doubled in the average dwelling in the past thirty years. Flat glass also is used in mirrors, partitions, some kinds of furniture, and in industry. See **WINDOW**.

Glass Containers are used for packaging food, beverages, medicines, chemicals, and cosmetics. Glass jars and bottles are made in a wide variety of shapes, sizes, and colors. More than 21,000,000,000 glass containers are made each year in the United States. In the late 1950's, this was about 120 containers apiece for each man, woman, and child in the country. Many are for common uses such as milk bottles or jars for home canning. Others are made from special glass formulas to make sure there will be no contamination or deterioration of blood plasma, serums, and chemicals stored in them. See **BOTTLE**.

Glass-Ceramics are materials first melted and fabricated as glass. They are then changed into strong, hard, crystalline substances. See **PYROCERAM**.

Specialty Glasses include many types of glass invented since 1900. Until this century almost all the glass used was flat glass, glass containers, optical glass, and decorative glassware. Below, you will find descriptions of eighteen important specialty glasses.

Laminated, or Safety, Glass is a "sandwich" made by placing a layer of plastic material between two thin layers of flat glass. The outside layer of glass may break when hit by a flying object, but the plastic layer is elastic and stretches. This holds the broken pieces of glass together and keeps them from flying in all directions. Laminated glass is used where broken glass might cause serious injuries, as in automobile windshields.



GLASS ANSWERS MANY NEEDS...

Glass Transmits Light. Because of this, glass is invaluable for such uses as eyeglasses, windows, microscopes, telescopes, and electric-light bulbs.

Bullet-Resisting Glass is multilayer laminated glass. In thicknesses of several inches, it will stop heavy-caliber bullets even at close range. The glass is heavy enough to absorb the energy of the bullet, and the several plastic layers hold the shattered fragments together. Such glass is used in banks, pressure-cooking vessels, and military tanks and aircraft.

Tempered Glass, unlike laminated glass, is a single solid piece which has been given a special heat treatment. It looks, feels, and weighs the same as ordinary glass. But it can be up to five times as strong! Tempered glass is used widely for all-glass doors in stores, for the side and rear windows of automobiles, and for other special purposes. It is hard to break even when hit with a hammer. When it does break, the whole piece of glass collapses into small, dull-edged, relatively harmless fragments.

Colored Structural Glass is a heavy plate glass, available in many colors. It is used in buildings as an exterior facing, and for interior walls, partitions, and table tops.

Opal Glass has small particles in the body of the glass which disperse the light passing through it. This makes the glass appear milky. Fluorides are among the ingredients necessary to produce opal glass. This glass is widely used in lighting fixtures and for tableware.

Foam Glass, when it is cut, looks like a black honeycomb. It is filled with many tiny cells of gas. Each cell is surrounded and sealed off from the others by thin walls of glass. Foam glass is so light that it floats on water, like cork, and often is used as a substitute for cork. It is widely used as a heat insulator in buildings, on steam pipes, and on chemical equipment. It can be cut into various shapes with an ordinary saw.

Glass Building Blocks are made from two hollow half-sections sealed together at a high temperature. Glass building blocks are a good insulator against heat or cold because of the dead-air space inside. Laid together like bricks in large panels, glass blocks are a common



Glass Resists Acid. This makes glass useful in laboratories and industry.



Glass Resists Electricity. Fuse plugs are just one of the electrical uses of glass.

sight in modern factories, office buildings, and apartment buildings.

Heat-Resistant Glass is high in silica and boric oxide. Its low coefficient of expansion enables it to stand great temperature changes without cracking. This is important in chemical and cooking ware, and in other industrial and domestic uses.

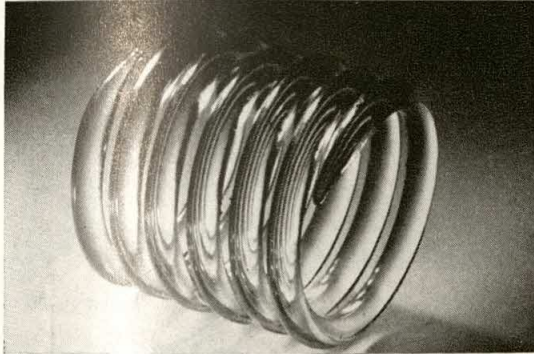
Laboratory Glassware includes beakers, flasks, test tubes, and special chemical apparatus. It is made from heat-resistant glass to withstand severe temperature shock, and also because this glass is much more resistant to chemical attack than ordinary glass.

Glass for Electrical Uses. Ordinary glass has certain properties which make it useful in electrical applications: transparency, ability to resist heat, resistance to the flow of electricity, and ability to seal tightly to

metals without cracking. Because of these properties, glass is used each year in over two billion electric-light bulbs and hundreds of millions of radio and television tubes.

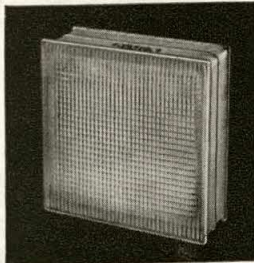
Heat-Conducting Glass. Ordinary glass serves as an excellent insulator against electricity, rather than a conductor of it. However, glass can be sprayed with a thin, almost invisible coating of certain chemicals. This film will conduct enough electricity to heat the glass, even though the glass itself does not carry any current. This fact makes it possible to manufacture electrically heated food warmers, room heaters, and glass windshields for airplanes.

Glass Tubing is used to make fluorescent and incandescent lamps, radio and television tubes, neon signs,



Corning Glass Works

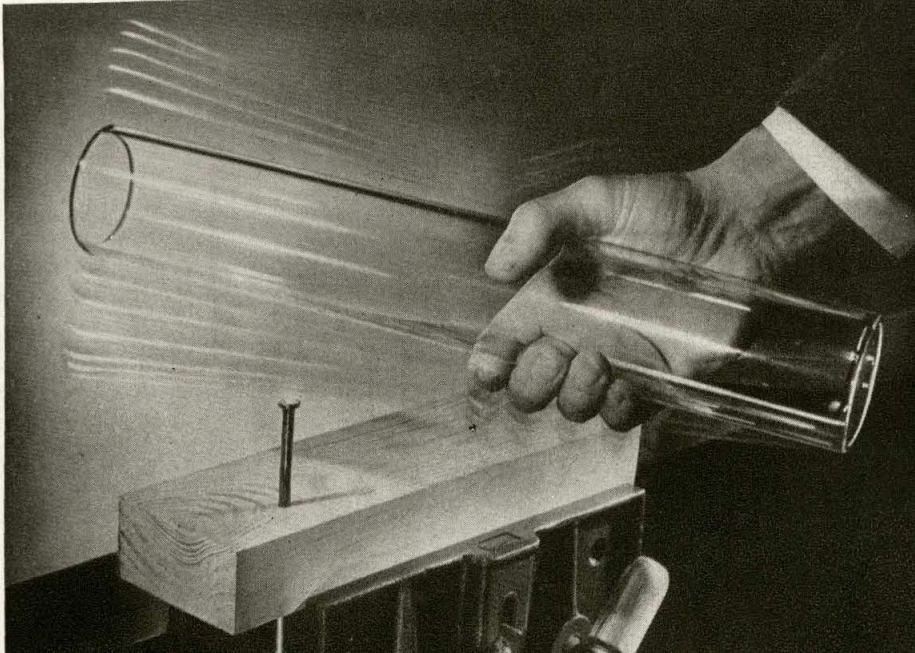
Glass Is Flexible. It can be made into springs which will bend countless times without breaking.



Pittsburgh Corning Corp.

Glass Is Durable. Glass building blocks stand up against the wear and corrosion of weather.

Glass Is Tough. A tempered glass tube is so strong it can be used to hammer a nail into a block of wood. Yet it looks and feels just like ordinary glass.



Corning Glass Works

glass piping, and chemical apparatus. Tubing is made from many different kinds of glass and in many sizes.

Fiber-Glass manufacture has grown to a multi-million dollar industry in the United States, since its development in the 1930's. Each fiber is a fine but solid rod of glass, often less than one-twentieth the width of a human hair. These tiny rods can be loosely packed together in a wool-like mass for heat insulation. They also can be used like wool or cotton fibers to make glass yarn, tape, cloth, and mats. Fiber glass has many uses, as for electrical insulation, chemical filtration, firefighters' suits, and, combined with plastic, to make automobile bodies. It is a popular curtain material because it is fireproof and is easily washed. See FIBER GLASS.

Ray-Absorbing Glass and **Ray-Transmitting Glass** are special kinds which can transmit, modify, or block heat, light, X rays, and other types of rays. For example, ultraviolet glass admits the tanning rays, or ultraviolet rays, of the sun, but blocks out part of the heat. Other glass transmits heat rays quite freely but passes very little visible light. Polarized glass cuts out the glare of brilliant light. One-way glass makes it possible to look through a window without being seen from the other side of the glass. See POLARIZED LIGHT.

Optical Glass is used for eyeglasses, microscopes, telescopes, camera lenses, and many less-familiar instruments used in factories and laboratories. The raw materials must be pure, so that the resulting glass is almost flawless. The painstaking care required for producing optical glass makes it expensive compared with other kinds. See GLASSES; LENS; MICROSCOPE; TELESCOPE.

Invisible Glass is used principally for "coated" camera lenses and eyeglasses. The coating is a special chemical film on the glass which decreases the normal loss of light by reflection. This allows more light to pass through the glass. See POLAROID CAMERA.

Photosensitive Glass can be exposed to ultraviolet light and to heat so that any pattern or photograph can be

MAKING

Batch Ingredients—sand, soda ash, lime, and other materials—are weighed, mixed, and poured into furnace.

Gas Flames melt the batch into glass at about 3000°F.

Molten Glass forms a white-hot lake 5 feet deep and 125 feet long inside the furnace.

Continuous Tank Furnace

3. MACHINE SHAPING

A stream of glass flows from the furnace and is cut off in gobs, which are fed into shaping machines.

1. DRAWING

Molten glass is drawn, or pulled, from the furnace to form rods, tubes, and flat glass.

2. BLOWING BY HAND

Skilled workmen shape by hand many articles such as goblets and vases.

A Gatherer collects a gob of hot glass on the blowpipe.

A Blower puffs into the blowpipe and blows glass into shape of a goblet.

MAKING PLATE GLASS

DRAWING, ANNEALING, and CUTTING

Wide rollers flatten glass into a strip.

Glass strip is annealed, or heat-treated, in a 400-foot lehr.

Inspectors check glass for defects.

Workmen cut the glass strip into sheets by hand.

Glass strip is cooled and its edges trimmed.

Glass sheets are raised by vacuum cups and moved to storage racks.

White-hot glass flows from the melting furnace into forming rolls, which shape the molten glass into a semisolid continuous ribbon.

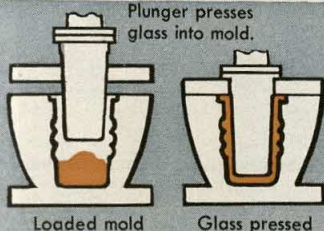
Broken glass is crushed and returned to furnace to be melted again.

and SHAPING GLASS

PRESSING can be done in several different types of molds.



Empty split mold



Loaded mold

Glass pressed

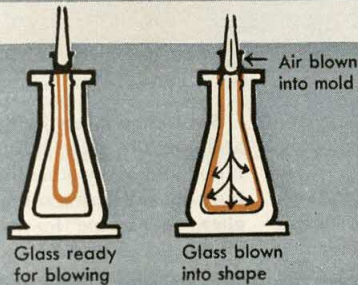


Finished article

BLOWING also can be done in various kinds of molds.



Empty paste mold



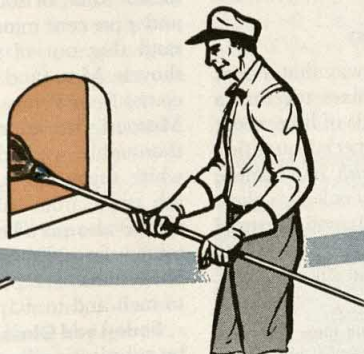
Glass ready for blowing

Glass blown into shape



Finished article

A **Servitor** shapes a stem and base which is added to the glass goblet.



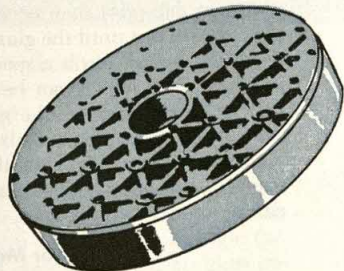
A **Blower** reheats the goblet to about 1800° F. in a "glory hole" to keep the glass soft enough to work.



A **Gaffer**, in charge of the entire operation, does the final shaping and finishing.

4. CASTING

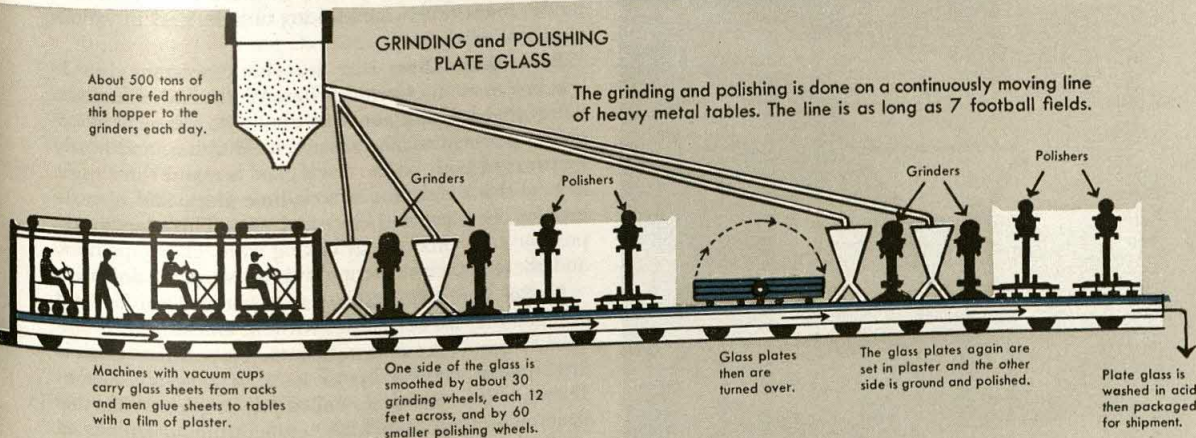
Large glass objects, such as the 200-inch lens of the Mt. Palomar telescope, are cast in molds. But casting is seldom used in mass production.



GRINDING and POLISHING PLATE GLASS

About 500 tons of sand are fed through this hopper to the grinders each day.

The grinding and polishing is done on a continuously moving line of heavy metal tables. The line is as long as 7 football fields.



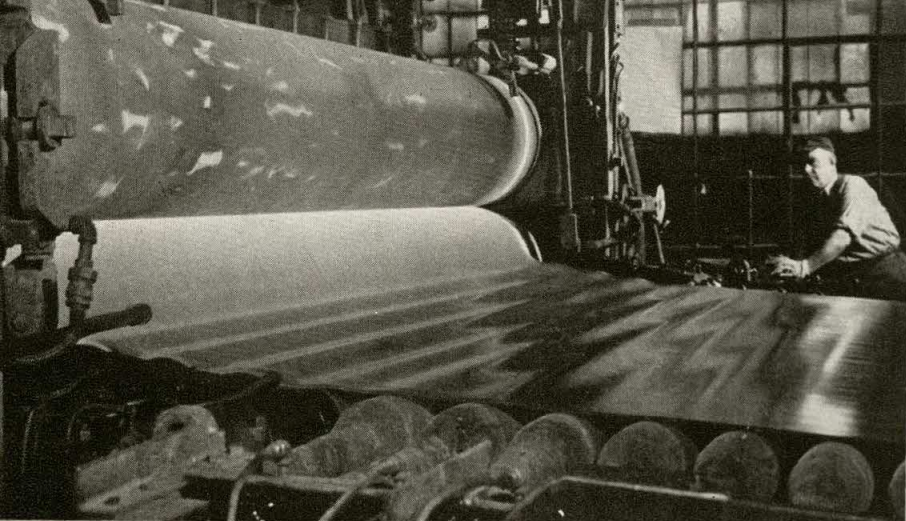


Plate Glass Begins to Take Shape. The white-hot glass comes from a melting tank at the left. The workman adjusts the rollers so that they form the glass into a sheet of desired thickness and width. Then the glass sheet enters a *lehr*, to the right of this picture, where the glass is annealed.

This series, Pittsburgh Plate Glass Co.

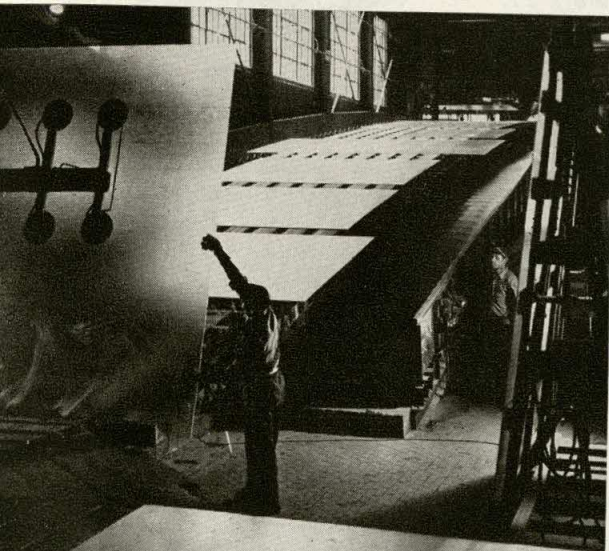
reproduced within the body of the glass itself. Since the photographic print then becomes an actual part of the glass, it will last until the glass is broken.

Photochemical Glass is a special composition of photo-sensitive glass which can be cut by acid. Any design can be reproduced on the glass from a photographic film. Then when the glass is dipped in acid the extra glass is cut away, leaving the design in the glass in three dimensions. By this means, lacelike glass patterns can be made.

Recipes for Making Glass

Glass is made in somewhat the same way that a cook makes hard candy. The glassmaker mixes together a large amount of sand and small amounts of lime, soda, and other materials, to give the glass special qualities. The glassmaker heats the mixture, or *batch*, in a furnace until it is a sirupy mass. When the sirup cools, it is glass. Between two and three million tons of sand are used each year to make glass in the United States. However, for some special kinds of glass no sand at all is used.

Riding the Camel-Back. After annealing, the glass is cut into plates. The plates move along a conveyor, or *camel-back*. Then large suction cups lift the plates onto storage racks.



Soda-Lime Glass is the kind of glass used for plate and window glass, most containers and electric-light bulbs, and many other industrial and art objects. About nine out of every ten tons of glass made are soda-lime glass. The "recipe" for making soda-lime glass has been almost the same for hundreds of years. Trial and error over the centuries no doubt taught men the best proportions of sand, soda, and lime to use. The composition is about 72 per cent *silica*, or sand; 15 per cent *sodium oxide*, or soda; 9 per cent *calcium oxide*, or lime; and 4 per cent minor ingredients. The silica comes from sand dug out of sandstone quarries by huge power shovels. Most sand for glassmaking in the United States comes from Pennsylvania, West Virginia, Illinois, and Missouri. The sandstone is crushed into fine sand and thoroughly washed. At this stage it looks much like white sugar. Sodium oxide usually comes from soda ash made from salt, but sodium nitrate and sodium sulfate also may be used. Calcium oxide is usually obtained from limestone or dolomite. Soda-lime glass always has been popular because it is inexpensive, easy to melt and to shape, and reasonably strong.

Soda-Lead Glass, commonly called *lead glass*, is made by substituting lead oxide for calcium oxide and often for part of the silica used in soda-lime glass. Soda-lead glass is soft and easy to melt. It is much more expensive than soda-lime glass. Soda-lead glass has such valuable electrical and optical properties that it is widely used for the finest tableware and art objects, and in various electrical products.

Borosilicate Glass is a heat-shock resistant glass. It was first made by Corning Glass Works under the trade name *Pyrex*. Pyrex contains about 80 per cent silica, only 4 per cent alkali, 2 per cent alumina, and nearly 13 per cent boric oxide. Such glass is about three times as heat-shock resistant as soda-lime glass, and is excellent for chemical and electrical uses. This glass makes possible such products as baking ware, glass pipe lines, and the 200-inch telescope disk at Mount Palomar.

96 Per Cent Silica Glass can be heated red hot and plunged into ice-cold water without cracking! It is produced from a special borosilicate composition which is first treated chemically to leave a porous skeleton. Therefore it is sometimes called *porous glass*. When this skeleton is fired at a high temperature, it shrinks as much as 35 per cent. The pores close and the final

Plastering the Glass. Before being ground and polished, the sheets of glass are imbedded in plaster on a metal-topped conveyor belt. This is done so the glass will not slip off the conveyor while it is being ground and polished. Plastering the glass requires much skill and training, because the plates must lie perfectly flat on the conveyor.



transparent, nonporous glass is obtained. This glass is used principally for chemical ware. It is made under the trade name *Vycor* by the Corning Glass Works.

Colored Glass. The early glass made by the Egyptians and Romans was always colored, because of accidental impurities. Today certain oxides are added deliberately to color glass. For example, one part of nickel oxide in 50,000 produces a tint which may range from yellow to purple, depending on the base glass. One part of cobalt oxide in 10,000 gives an intense blue. Red glasses are made with gold, copper, or selenium oxides. Many other beautiful colors can be produced in glass with other chemicals.

How Glass Is Made

If you can visit a glass plant you will have an unforgettable experience. No other kind of factory looks quite like it. Here are huge bins, or *silos*, which hold the raw materials for glassmaking—the sand, soda ash, limestone, borax. These materials all are dry powders which look much alike, but are capable of producing greatly different results. Here are giant roof ventilators and huge stacks to release the terrific heat required to melt these dry powders to a white-hot liquid. At the *hot end* of the glass plant are the furnaces, large and small, with the molten glass inside, so hot it can blind a human eye. Here are the men and machines which transform this hot, sirupy liquid into the hard, rigid, brittle solid we call *glass*. Here is an apparently senseless maze of gas pipes, water pipes, air pipes, and electrical conduits to feed the furnaces, operate the machines, and cool the men. You hear an ear-numbing roar of fuel gas burning in the furnaces, a clatter and rumble from the machines, and you feel a smothering blanket of heat.

Mixing. The principal raw materials come to the glass plant in railroad cars and are stored in large silos. After they are carefully weighed and mechanically mixed in the proper proportions, the glassmaker adds *cullet*. Cullet is waste glass from a previous melt of the same kind of glass. Adding 20 to 40 per cent cullet to the new batch not only uses material which would otherwise be wasted, but also actively assists the melt-

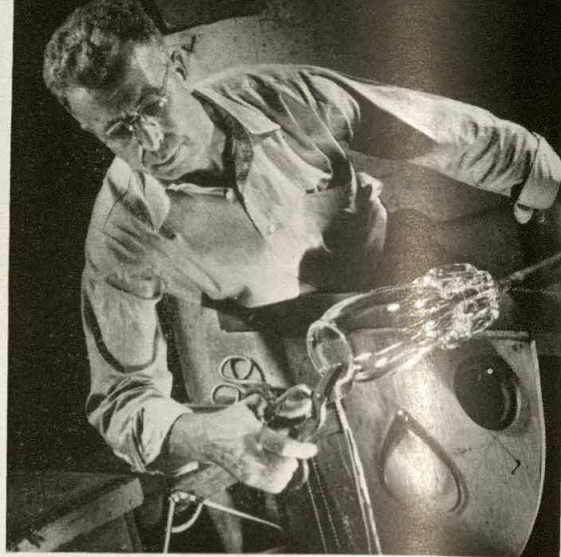
ing. The batch then goes to the melting units in batch cars, in hoppers, or on conveyor belts.

Melting. In early times the batch was melted in tiny clay pots, also called *refractory pots*, two or three inches wide and deep. Wood or straw was used as fuel. Special refractory pots still are used, but they are much larger, often holding up to 3,000 pounds of glass. The fuel is gas or oil. Often there are 6 to 20 pots in a single furnace. Optical glass, rolled plate glass, and art glass are made in refractory pots.

Larger quantities of glass are made in furnaces which are called *day tanks*, because the process that goes on in

Whirling Grinding Disks, each about 12 feet across, use sand to grind off bumps and imperfections from the glass. Later the glass plates are polished by smaller felt-covered disks.





This series, Corning Glass Works
Gaffer, above, is a skilled glass blower in charge of a group of hand glass workers. The gaffer is trimming extra glass from the top of a still-soft glass vase.

Hot Gob of Glass Is Touched to an Urn, left, and the gaffer cuts it off to form a handle. Pinned to the wall in the background is a rough sketch of the urn, which the workers use to guide them while making it.

them takes about 24 hours. The day tank is filled with raw materials, the glass is melted, and all the glass is used before the furnace is filled again. These day tanks hold one to four tons of glass.

The largest melting furnaces are called *continuous tanks*. These usually hold 50 to 100 tons of molten glass, but may hold as much as 1,000 tons. The operation is continuous. The raw materials are fed into the loading end as rapidly as molten glass is removed from the working end. The loading, melting, and working go on, day after day, from the time the fires are first lighted until they are extinguished at the end of a period called a *campaign*. Often a campaign lasts as long as four years. The length of a campaign almost always is determined by the wearing-out of the heat-resistant clay walls of the furnace, which are constantly worn and dissolved by the hot glass.

How Glass Is Shaped

There are four main methods of shaping glass: *blowing*, *pressing*, *drawing*, and *casting*.

Blowing. *Offhand glass blowing*, or blowing glass without the use of molds, is an art more than 2,000 years old. A hollow iron *blowpipe*, four or five feet long, is dipped in molten glass, some of which sticks to the pear-shaped end of the blowpipe. Lifting the pipe to his mouth, the workman blows gently into it until the glass bulges out to form a bubble, or hollow bulb. This glass bulb the workman can squeeze, stretch out, swirl, rehear, and cut, much as a cook may work with hot taffy candy. From time to time the workman reheats the glass to keep it soft. When the still red-hot glass has been given its final shape, it is broken from the pipe.

Glass also can be blown in iron molds, by hand or by complicated machinery.

Pressing is accomplished by dropping a hot gob of glass in a mold, then pressing it with a plunger until it spreads and fills the inside of the mold. To be pressed, an article must be of such a shape that the plunger can be withdrawn. Baking dishes, glass blocks, lenses, and water tumblers often are pressed. Again, as with blowing, pressing can be done by hand or by machinery, with single or multiple molds. Press-and-blow machines use a combination of the two methods to form the article. Many containers are made by these machines.

Drawing. Sheet and plate glass, tubing, and fiber glass all are made by essentially the same method, *drawing*. The Fourcault, Libbey-Owens-Ford, and Pittsburgh Plate processes for making window glass differ only in detail. In each case a wide sheet of glass is drawn directly from the molten glass, cooled, and cut to size. Plate glass passes in a wide sheet through water-cooled rollers, is annealed, ground, and polished, and is then cut. Tubing is made in nearly the same way, except that a hollow tube of glass is drawn directly from the hot glass. Fiber glass passes through tiny holes in the bottom of the furnace and is drawn away at a speed of two miles a minute. All these processes run continuously, day and night.

Casting. The 200-inch-wide telescope disk for the Mount Palomar Observatory in California was made by filling a huge mold with hot glass from 750-pound ladles. There was no other way to make such a huge piece of glass. This casting method is occasionally used for glass architectural pieces and art glass.

Lamp Working is a method of reshaping glass into new forms after it once has cooled. Lamp workers reheat various kinds and sizes of glass tubing and rod. They then can bend, twist, pull out, and seal the softened glass into a variety of objects. In this way they



Workman Grinds Rough Places from Glass Articles after they have been shaped by pressing or blowing.



A Master Engraver uses fast-spinning cutting wheels to copy a design onto a handmade crystal bowl.

make miniature animals, vases, sailing ships, glass eyes, scientific apparatus, and parts for radio and television tubes, incandescent lamps, and other industrial equipment. Many small parts for the electrical, chemical, and medical industries are made on high-speed automatic machines by reworking the glass.

Annealing is a process that removes the stresses and strains normally present in glass objects after they have cooled. This is done by reheating the glass, then gradually cooling it in accordance with a definite time-and-temperature schedule. For instance, glass vases made by glass blowers are placed on a slowly moving metal belt in a long, narrow, heated oven called a *lehr*, where they are reheated, then gradually cooled. After they have been annealed they are ready to be decorated. See **ANNEALING**.

Tempering is a process in which a glass article that is already formed is reheated until almost soft. It is then chilled suddenly by blasts of cold air or by plunging it in oil or certain chemicals in a liquid state. This makes the glass much stronger than ordinary glass.

Testing. In almost every glass plant, engineers often test samples taken directly from the furnaces, to make sure the glass is of good quality and has the desired properties. Samples of the ware also are tested for size, proper annealing, and sometimes for chemical durability, heat-shock resistance, and other qualities.

How Glass Is Decorated

Several preliminary finishing operations are often necessary before glass articles can be decorated. Excess glass must be removed from blown ware. Sometimes the glass piece is revolved in front of an intensely hot gas flame. The sudden expansion of the hot, narrow band of glass revolving opposite the flame makes it break off from the cooler glass next to it. In other

cases, the ware may be supported upside down, even hotter flames are applied, and the glass melts and separates. The weight of the extra glass makes it drop into a cullet bin, from which it is sent back to the furnace to be used again. The extra glass also can be cut off by scoring the glass piece with a diamond or steel wheel, and then snapping off the excess glass with sudden pressure. If the cut, or severed, edges of the glass article are not smooth enough, they may be polished with fine abrasives, or with flames in a fire-polishing machine.

Etching. Hydrofluoric acid and some of its compounds are the only chemicals which readily dissolve glass and eat it away. Glass articles dipped in, or sprayed by, these chemicals are said to be *etched*. Depending on glass composition, concentration of fluorides, and time, an etched-glass surface may be rough, frosted, and almost opaque, or it may have a translucent, soft, satiny-smooth appearance. Electric-light bulbs are frosted with this satiny finish. Pitchers, water tumblers, and art glass often are etched with intricate designs. They are first painted with an acid-resistant chemical, or *resist*, to protect the parts of the glass outside the desired pattern. Then acid eats away the unpainted surface of the glass, leaving the pattern.

Sandblasting gives a translucent surface, usually rougher than that obtained by etching. Compressed air blows coarse, rough-grained sand against the glass, often through a rubber stencil, to form a design. The labels on chemical ware are often sandblasted. Lighting ware, ovenware, and plate and window glass often are decorated or made translucent by sandblasting.

Cutting is a process of actually wearing away considerable quantities of the original glass by holding it against spinning sandstone or carborundum wheels. The workman follows a design previously marked on

the article. The cuts may be quite deep. The original luster is restored to the rough, cut surfaces by etching or by polishing with very fine abrasives.

Copper-Wheel Engraving permits the fullest expression of the artist's creations in glass—delicate, detailed, flowing designs, faithfully reproduced in three dimensions. Most of our modern masterpieces in glass are engraved. The process involves the painstaking cutting of glass with dozens of abrasive-fed copper wheels, big and little, thick and thin.

Fired Decorations. Colored enamels and lusters can be applied to glass by hand painting, by using decalcomanias, or by the silk screen printing process. When these enamels are heated to the proper temperature, they fuse to the glass and thus become part of the article. Tumblers, jugs, pitchers, lighting ware, novelties, and many other glass products are decorated in this way. See DECAL; ENAMEL; SILK SCREEN PRINTING.

History of Glass

Early Times. Even before man learned the secret of glassmaking, nature made glass in two different ways. When lightning strikes sand, the heat sometimes fuses the sand into long, slender glass tubes called *fulgurites*, which are commonly called petrified lightning. The terrific heat of a volcanic eruption also sometimes fuses rocks and sands into a glass called *obsidian*. Early man discovered many uses for obsidian. He shaped it into knives, arrowheads, jewelry, and money. See OBSIDIAN.

We do not know exactly when, where, or how man first learned to make his own glass. We believe this great event occurred in Syria or Egypt, sometime between 10,000 and 3000 B.C. We do know that from 1500 B.C. until at least 300 B.C. Egypt was the center of glass manufacture. Sand, soda, and wood fuel were all readily available there. Even so, glass manufacture was slow, laborious, and costly. Blowing and pressing glass were then unknown, furnaces were small, the clay pots of poor quality, and the heat hardly sufficient for proper melting. Still, as the worker's skill increased, he learned how to make colored glass jewelry, cosmetics cases, and tiny jugs and jars. Those who could afford them—the priests and the ruling classes—considered these glass objects as valuable as jewels. Soon the merchants learned that wines, honey, and oils could be carried and preserved far better in glass than in wood or clay.

The invention of the blowpipe by some unknown artisan about 300 B.C. began to remove glass from the luxury list. Glass manufacture flourished in all the countries under Roman rule. In fact, the first four centuries of the Christian Era may justly be called the First Golden Age of Glass. The men of these early days were masterful glassworkers. They knew how to make a relatively clear, transparent glass. They did offhand blowing, painting, gilding. They knew how to build up layers of glass of different colors and then cut out designs in high relief. The celebrated Portland vase made in Rome about A.D. 70 is an example of this art. It is regarded as the most valuable art glass object in the world. The British Museum refused an offer of \$50,000 for it. See GLASSWARE (picture).

The Middle Ages. Little is known about the glass industry between the decline of the Roman Empire and

- c.3000 B.C. First glass made by man. Place unknown.
- c.1500 B.C. Glass pressed in open molds in Egypt.
- c.300 B.C. Blowpipe for blowing glass invented, perhaps by the Phoenicians.
- c.200 B.C. Glass blown into molds in Rome.
- c. A.D.1 First transparent glass sheets made in Rome.
- c.1000 Venetians began to dominate glass manufacture.
- 1535 First glass made in the western hemisphere by Spanish craftsmen at Puebla de los Angeles in Mexico.
- 1674 Lead glass made in England by George Ravenscroft.
- 1688 Plate glass produced by casting by Louis Lucas in France. This led to the wide use of mirrors.
- 1790 Good optical glass produced by Pierre-Louis Guinand in France, by stirring glass in melting pots.
- 1879 Glass bulb for Edison's electric light blown by Fred Duerlein, Corning Glass Works in New York.
- 1897 Continuouslehr for annealing plate glass installed by Marsh Plate Glass Company at Floreffe, Pa. This cut three days from the production time required for a sheet of plate glass.
- 1902 Machine to draw a continuous sheet of glass developed by Emile Fourcalt of Belgium.
- 1903 Automatic bottle-making machine invented by Michael J. Owens at Toledo, O.
- 1903 Laminated glass invented by Edouard Benedictus in France.
- 1908-1915 Heat-shock resistant borosilicate glass (Pyrex) developed by Eugene C. Sullivan and William C. Taylor of the Corning Glass Works.
- 1908-1917 Sheet window-glass drawing machine invented by Irving W. Colburn, and developed by Libbey-Owens Sheet Glass Company at Charleston, W. Va.
- 1920 Polarized glass invented by Lewis W. Chubb of Westinghouse Electric Company, East Pittsburgh, Pa.
- 1926 Automatic machine to blow electric-light bulbs developed by Corning Glass Works.
- 1926 Mass production of safety glass developed by Libbey-Owens Glass Company.
- 1926 Machine to draw sheet window glass directly from the furnace developed by Pittsburgh Plate Glass Co.
- 1930 Insulated window glass (Thermopane) invented by C. D. Haven in the United States.
- 1931-1938 Fiber glass developed by the Owens Illinois Glass Company and Corning Glass Works.
- 1934 Largest piece of man-made glass in the world, the 200-inch, 20-ton telescope disk for Mount Palomar Observatory, was cast by Corning Glass Works.
- 1939 96 per cent silica glass developed by Harrison Hood and Martin Nordberg of Corning Glass Works.
- 1939 Invisible coatings on glass, to reduce light reflection, developed independently by Katherine B. Blodgett of General Electric Laboratories, and Hawley Cartwright and Arthur F. Turner of Massachusetts Institute of Technology.
- 1942 Foam glass developed by the Pittsburgh Corning Corp.
- 1945 Mass production of optical glass developed by Corning Glass Works.
- 1947 Photosensitive glass developed by S. D. Stookey of Corning Glass Works.
- 1951 Photochemical glass developed by Corning Glass Works.
- 1955 Lightweight glass solder developed by Owens-Illinois Glass Company. The material becomes ready for use at relatively low temperatures. It has been used experimentally on color-television tubes.
- 1955 Lo-Tran glass for sun glasses developed. Glass lenses made from Lo-Tran glass let in only 12.5 per cent of the outside light.
- 1957 Pyroceram developed by S. D. Stookey of Corning Glass Works. Scientists first used it in the nose cones of guided missiles.

the 1000's. During the Crusades, glass manufacture began again in Venice. By 1291 an elaborate guild system of glassworkers had been set up. Equipment was transferred to the island of Murano near Venice, and the whole industry was placed under control of the fearsome Council of Ten. Thus began not only the Second Golden Age of Glass, but also a period whose history reads like a fairy story. The penalty for betraying the secrets of glassmaking was death. Armed guards patrolled the streets of Murano night and day. Hired assassins killed French and English agents who tried to bribe the workers to learn the secret of glassmaking. For the loyal workers, life was prosperous and rewarding. They responded by blowing some of the most delicate and graceful glass the world has ever seen. They perfected *Cristallo* glass, the first nearly colorless, transparent glass, which could be blown to extreme thinness in almost any shape. From *Cristallo* they made intricate lacework patterns in goblets, jars, bowls, cups, and vessels of great beauty. In the 1100's and 1200's, the art of making stained-glass windows reached its height throughout Europe. See STAINED GLASS.

Early American Glass. The first factory in what is now the United States was a glass plant built at Jamestown, Virginia, in 1608. Within a year this venture failed. The Jamestown colonists tried glassmaking again in 1620, but the Indian massacre of 1622 ended this attempt. The actual start of the industry in this country came in 1739 when Caspar Wistar built a glass plant in Salem County, New Jersey, which operated until 1781. A few glass plants, also called *glass houses*, had started and failed in the period between Jamestown and Wistar, but most colonists during this time lived and died without seeing many pieces of glass.

Wistar is one of the great names of early American glass (see GLASSWARE). The second great American glassmaker was Henry William Stiegel, unofficially known as Baron Stiegel. In just nine years of glassmaking at Manheim, Pa., Stiegel made the finest art glass this country had seen. See STIEGEL, HENRY W.

The third famous early American glass name is *Sandwich*, from the Boston and Sandwich Glass Co., founded by Deming Jarves in 1825. It was originally believed to be the first company in America to produce pressed glass. But this honor is now given to the Bakewell, Page, and Bakewell Company of Pittsburgh, which began to make pressed glass earlier in 1825. Both these and many other companies soon made large quantities of inexpensive glass, both pressed and blown. Every effort was made to produce a "poor man's cut glass." In lacy Sandwich, for example, thick, heavily textured areas were placed in direct contrast to thinner, polished areas, to give an inexpensive lacelike effect.

In the early 1800's the greatest demand was for window glass. At that time window glass was called *crown glass*. It was made by blowing a bubble of glass, then spinning it until it was flat. This left a sheet of glass with a bump, or *crown*, in the center.

By 1850 plate glass was becoming popular. Bottles and flasks were first used principally for whisky, but the patent-medicine industry soon required large numbers of bottles. The screw-top Mason jar for home canning appeared in 1858. By 1880 commercial food packers began to use glass containers. Glass tableware was used in steadily increasing quantities. The discovery of pe-

troleum and the appearance of the kerosene lamp just before the Civil War led to a demand for millions of glass lamp chimneys. All these developments combined to expand the market for glass.

But even in the year 1890, a Roman glass blower would have felt quite at home among the operations in most American factories. The glass composition was almost unchanged from earliest days; the blowpipe, tongs, molds, and other tools were very similar; and the methods of pressing and blowing were still the same. Each company had certain so-called secrets which were carefully guarded and often handed down from generation to generation. Most of these processes were not secrets at all or, if they were, were not worth guarding.

Modern Glassmaking. After 1890, the development, manufacture, and use of glass increased so rapidly as to be almost revolutionary. The science and engineering of glass as a material are now so much better understood that glass can be hand tailored to meet an exact need. Any one of thousands of compositions may be used. Machinery has been developed for precise, continuous manufacture of sheet glass, tubing, containers, bulbs, and a host of other products. New methods of cutting, welding, sealing, and tempering, as well as better glass at lower cost, have led to the use of glass in completely new fields. These include pipe lines, cooking ware, building blocks, and heat insulation.

Ordinary glass turns brown when it is exposed to atomic radiation, so glass companies developed a special nonbrowning glass to be used in observation windows in atomic-energy plants. More than ten tons of this glass are used in windows in one atomic-energy plant. Automobile manufacturers in 1953 began building cars with fiber-glass-plastic bodies. These materials are now used in architectural panels, which are used to sheath the walls of buildings. They are also used to make the hulls of boats and such products as missile *radomes* (housings for radar antennas).

The Glass Industry Today

Most of the flat glass, glass containers, tubing, and pressed and blown glassware in the United States is made by about 425 large companies. However, there are more than a thousand smaller companies that cut, decorate, and shape the products made by the larger glass manufacturers. The United States glass industry produces more than two billion dollars worth of glass products a year and has over 125,000 employees. The leading glass states include California, Illinois, Indiana, New Jersey, New York, Ohio, Pennsylvania, and West Virginia. The leading Canadian glass-producing provinces include Ontario and Quebec.

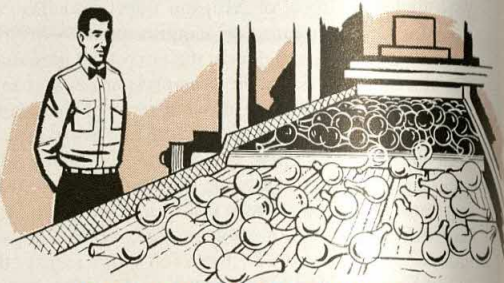
Before 1890 most of the glass was made by hand by many small manufacturers. The development of large furnaces and automatic machines in the 1900's made it possible for one large manufacturer to turn out more glass than had been made previously by many small companies. As a result, the number of glass-manufacturing companies became smaller, but the amount of glass produced became larger.

Changes in the fuel used by the glass industry have made changes in the industry's location. In the early days when wood was used as fuel, glassworks were

THE MAGIC OF GLASS



FIBER GLASS FROM MARBLES
IN MAKING FIBER GLASS, A FIBER 90 MILES LONG CAN BE DRAWN FROM ONE MARBLE LESS THAN ONE INCH WIDE.



1000 LIGHT BULBS A MINUTE

AN AUTOMATIC GLASS-BLOWING MACHINE, CALLED A RIBBON MACHINE, CAN BLOW 1,000 LIGHT BULBS IN ONE MINUTE FROM A RIBBON OF RED-HOT GLASS.

located near forests. By 1880 coal had become the most widely used fuel for glassmaking, and the glass industry was located near large coal deposits. However, after 1880 natural gas became accepted as the perfect fuel for melting glass. Then the glass industry gradually moved westward into the natural-gas fields of western Pennsylvania, Ohio, and Indiana. Since World War II many new glass-manufacturing plants have opened near natural-gas supplies in the Southwest and on the West Coast.

All the major glass companies spend millions of dollars each year on research to find new ways to make better glass, and to find new uses for glass. The revolu-

GLASS TERMS

Bait is the tool dipped into molten glass to start any drawing operation.

Blister is a large gas bubble which is an imperfection in the glass.

Blow-over is a thin-walled bubble formed above a hand-blown mold to make it easier to crack off.

Checks are cracks, imperfections in the glass.

Cord is an imperfection which appears as long strings of different composition from the main body of the glass.

Doghhouse is the place where the batch is fed into a furnace.

Feeder is a mechanical device for producing and delivering gobs to a glass-forming unit.

Fire-over is to allow a melting unit to idle at operating temperature.

Gaffer is the man in charge of a shop of offhand glass blowers.

Gather is a gob, or blob, of glass collected on the end of a blowpipe.

Glory Hole is an opening in a small furnace used to reheat glass in handworking.

Marver is a flat plate, usually metal, on which a gather of glass is rolled, shaped, and cooled.

Moil is the glass remaining on a punty, or blowpipe, after a gob has been cut off for pressing, or after a piece of ware has been blown and cracked off.

Pontil, or Punty, is a solid iron rod, about the size of a blowpipe, used to carry and manipulate small amounts of glass.

Stone is any nonglassy material imbedded in the glass. It is an imperfection.

Teaser is a worker who regulates the fires and the loading of the batch into a furnace.

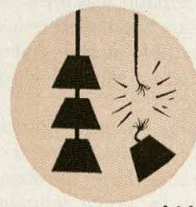


GLASS AS HARD AS STEEL
A PLATE OF TEMPERED GLASS ONE-HALF INCH THICK WILL NOT CRACK EVEN WHEN HIT BY A BASEBALL THROWN BY A BIG LEAGUE PITCHER.



GLASS JARS

AMERICANS EAT MORE THAN TWICE AS MUCH FOOD FROM GLASS JARS AS ALL THE REST OF THE PEOPLE IN THE WORLD EAT.

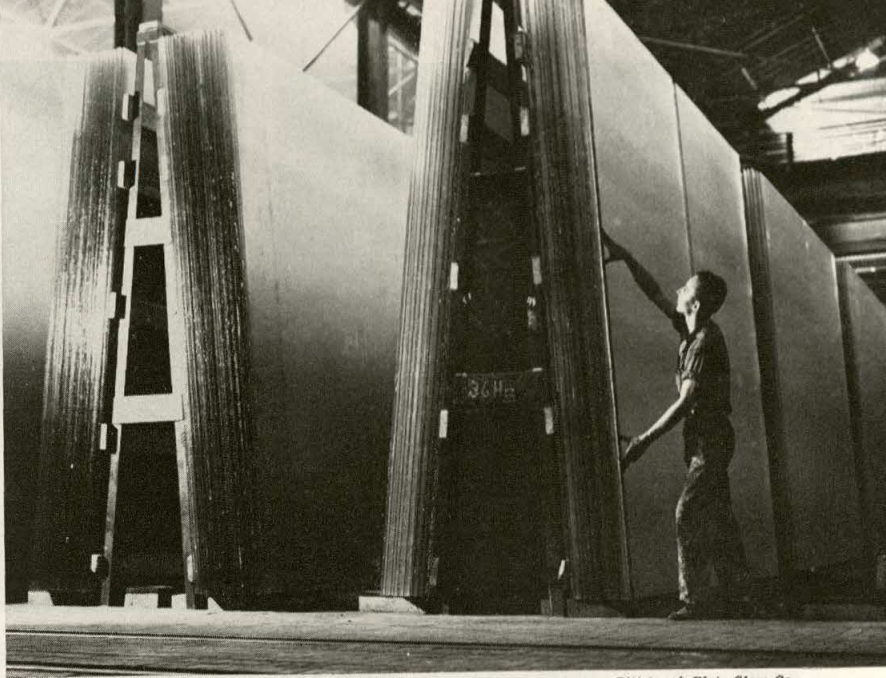


ROPES OF GLASS

WHEN WORLD WAR II CUT OFF ALLIED SUPPLIES OF HEMP, GLASS MANUFACTURERS MADE NON-ROTTING FIBER-GLASS ROPES. THESE GLASS ROPES HELD THREE TIMES THE STRAIN THAT WOULD BREAK A HEMP ROPE.

Unfinished Glass Plates

must be carefully stored until they can be ground and polished. The storage racks, which look like large upside down V's, are specially padded to protect the glass from damage.



Pittsburgh Plate Glass Co.

tionary developments in glass since 1900 have come largely from the laboratories of the glass-manufacturing companies.

Most of the countries of the world have glass industries. However, no country except the United States has developed to such a large degree the automatic machines for glassmaking which allow Americans to use inexpensive glass containers a single time, then throw them away. For many years Germany was the major world source for optical glass, for chemical glassware, and for Christmas-tree ornaments. However, during the two world wars the glass industry in the United States learned how to make optical glass on a commercial scale, began making chemical glassware in large amounts, and began using machines to blow Christmas-tree ornaments. Beautiful art glassware is made in many countries, particularly in Sweden and France.

Leading Glass Companies

Pittsburgh Plate Glass Company ranks as the largest glass company in the United States. The company also makes paints and chemicals. Company headquarters are in Pittsburgh, Pennsylvania. Owens-Illinois Glass Company is the second largest American glass company. Both Pittsburgh Plate Glass and Owens-Illinois are among the 100 largest manufacturers in the United States (see MANUFACTURING [table, 100 Leading Manufacturers]). Other glass companies, in order of rank, are Libby-Owens-Ford Glass Company, Corning Glass Works, and Anchor Hocking Glass.

C. J. PHILLIPS

Related Articles in WORLD BOOK include:

Annealing	Fiber Glass	Pyroceram
Antique	Field Glass	Sand
Bottle	Flower (Artificial Flowers)	Stained Glass
Cameo	Glasses	Stiegel, Henry W.
Corning	Glassware	Telescope
Ductility	Microscope	Tempering
Enamel	Mirror	Window
Etching		Wire Glass

Outline

I. Kinds of Glass in Everyday Life

- A. Flat Glass
- B. Glass Containers
- C. Glass-Ceramics
- D. Specialty Glasses

II. Recipes for Making Glass

- A. Soda-Lime Glass
- B. Soda-Lead Glass
- C. Borosilicate Glass
- D. 96 Per Cent Silica Glass
- E. Colored Glass

III. How Glass Is Made

- A. Mixing
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IV. How Glass Is Shaped

- A. Blowing
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- D. Casting
- E. Lamp Working
- F. Annealing
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V. How Glass Is Decorated

- A. Etching
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- D. Copper-Wheel Engraving
- E. Fired Decorations

VI. History of Glass

VII. The Glass Industry Today

VIII. Leading Glass Companies

Questions

- How is glass etched?
- How is glass colored?
- What kinds of glass are described in this article?
- How did the development of large furnaces and automatic machines affect the glass industry?
- What is lamp working?
- What is the difference between annealing and tempering glass?
- In what different ways can glass be decorated?
- Who made the first good optical glass?
- What is ray-absorbing glass? Invisible glass?
- What ingredients make up soda-lime glass?
- How is glass blown?
- What is sandblasting?
- What is fiber glass? How is it used? How was glass first made?

GLASS, CARTER. See VIRGINIA (Famous Virginians).

GLASS, WATER. See WATER GLASS.

GLASS-CERAMICS. See PYROCERAM.

GLASS FLOWERS. See FLOWER (Artificial Flowers).

GLASS SNAKE

GLASS SNAKE is a lizard found in the southeastern and central parts of the United States. Glass snakes are about two feet long, with tails twice as long as their bodies. When pursued the snake parts with some or all of its tail. The tail continues to wriggle and attracts the enemy, allowing the lizard to escape. A glass snake can live after it has broken into two parts, but the two parts will not join together again. A new tail grows but it is never as long as the original. The tail that is broken off dies.

Scientific Classification. Glass snakes belong to the family *Anguidae*. They are genus *Ophisaurus*, species *ventralis*.

CLIFFORD H. POPE

See also LIZARD.

The Glass Snake, in spite of its appearance, is not a snake but a lizard without legs. Like many other kinds of lizards, it can shed its tail and grow a new one in its place.

L. W. Brownell



GLASS WOOL. See FIBER GLASS (How Fiber Glass Is Made).

GLASSBORO STATE COLLEGE is a coeducational state school in Glassboro, N.J. It offers courses leading to bachelor's and master's in education degrees, and was founded in 1923. For enrollment, see UNIVERSITIES AND COLLEGES (table).

GLASSES are instruments which aid people whose eyesight is imperfect. Glasses are composed of two lenses mounted in a frame so that one lens is in front of each eye. The lenses help focus light rays so that they will fall properly on the retina and form a clear image.

Lenses in glasses are made of fine optical glass. They are ground, or shaped, to suit the defect of each individual eye. The kind of glasses a person needs is determined from a professional eye examination by an ophthalmologist or an optometrist.

Use of Glasses. Some eyes cannot correctly focus rays which come from distant objects. This inability is called *nearsightedness*. The eye focuses the image so that it falls short of the retina. The image on the retina is blurred, like the image a movie camera throws on a screen when it is out of focus. In cases of nearsightedness, a concave lens is used which *diverges*, or spreads out,



Bausch & Lomb

The Chinese Are Said to Have Invented Glasses long before they came into use in Europe. According to legend, they were used as early as 500 B.C. Marco Polo reported that he saw many Chinese wearing glasses in China about A.D. 1275.

the light rays, so they do not form an image until they reach the retina.

Some people can see distant objects but cannot focus well on close objects. This is called *farsightedness*. The eyeball is short and the focus of the light rays falls behind the retina. In these cases a convex glass is used which slants the light rays together, or *converges* them.

Some people may have imperfections in the curvature of the cornea. The surface of the eye may present a certain curvature in one direction and a different one in another. The rays which pass through the eye will not focus properly. This is called *astigmatism*. It can be corrected by a *toric* lens, which compensates for such variations in curvature.

Divided spectacles, or *bifocals*, provide both near and far vision. Each glass has two parts of different focal power. The lower section is smaller, and is used in close work. The upper section is used for distant vision. *Trifocals* include a third section, for medium distances. A glass worn in a single eye is called a *monocle*.

Lenses made to fit directly over the eyeballs, beneath the eyelids, are called *contact lenses*. They are practically invisible, but some people can wear them only for limited periods or they cause discomfort.

When glasses are well fitted, they can correct most defects of vision. But if they are not exactly measured to overcome the deficiency of each individual eye, they can be harmful and injure vision. They should always be fitted by a skilled person, and should be changed whenever the eyes change their power of focusing.

History. Records of spectacles go far back into ancient times, although doctors doubt that these early glasses were very helpful. Roger Bacon included information about spectacles in his book *Opus Majus*, published in A.D. 1268. Very little improvement was made until the 1700's, when the grinding of lenses was first based on the principles of light *refraction*, or the way light rays are bent when they travel through glass.



Bausch & Lomb

Crude Glasses Were Sold by Peddlers on the streets of European cities during the late Middle Ages. Such glasses were often worn for ornament, and sometimes fitted so badly that they did more harm than good to the person who wore them.

Colored glass is often used to protect the eyes from sun glare. Sunglasses are popular on bathing beaches. Some sunglasses make use of polarized materials to cut off glare. Other special glasses called *safety glasses* are used by workers in factories to prevent fragments of metal from entering the eye. Arc welders wear special glasses to cut off bright light.

HARRY S. GRADLE

Related Articles in WORLD BOOK include:

Astigmatism	Lens, Contact	Optometry
Eye	Nearsightedness	Polarized Light
Glass (Specialty)	Ophthalmoscope	Prescription
Glasses [Optical]	Optics	Refraction
Lens		

GLASSWARE. In the Toledo (Ohio) Museum of Art you can see two tiny, decorated glass bottles. One little bottle once contained rouge, the other, a powder for darkening the eyelids. This was the vanity case, or *compact*, carried by a Roman woman two thousand years ago. Of course, she had no electricity, telephone, radio, or television, no automobile, no controlled heating. But if she was a woman of wealth, no doubt she possessed not only her glass compact, but also some of the beautiful glass beakers and goblets, dishes and plates, flasks and ointment jars that were being made at that time. For beautiful glass has been made for thousands of years by people all over the world. And, because glass is such a stubborn, willful material, the hand-blown art glass of today is made with the same type of blowpipe, wood-forming blocks, and shears that the early Romans used. In some museum, two thousand years from now, today's art glass also will be preserved, because glass is almost unchanged and unchanging.

Early Glassware

Thousands of collectors seek old glassware, both because it is beautiful and because it is scarce. Glass made by the Egyptians, Romans, Venetians, and other early glassmakers is described in the article GLASS (History of



Bausch & Lomb

Bifocal Glasses Were Invented by Benjamin Franklin, to save the trouble of changing his glasses when looking from near objects to distant ones. Each bifocal lens contains parts of two lenses with different focusing powers.

Glass). Below are descriptions of some of the kinds of glassware valued by collectors.

Amberina Glass is colored by adding gold to the glass. It ranges in color from pale amber-yellow to rich ruby-red. It was patented in 1883 by Joseph Lock of Massachusetts.

Amelung Glass includes bowls, bottles, and jugs made by John Frederick Amelung at his New Bremen Glass Manufactory in Frederick County, Maryland, from 1784 to 1795. The glassware was engraved with mottoes, monograms, crests, flower wreaths, and vines.

Baccarat Glass. The glass works at Baccarat, France, specialized about 1850 in making red-glass paper weights filled with chemical snow and liquid. Many were used as toys.

Bohemian Glass. Beginning in the 1500's the Germans in the region of Bohemia and Silesia made large amounts of highly decorative glassware, often ornamented with castles, men, and animals. Casper Lehmann is credited with starting glass engraving in Bohemia in 1609.

Burmese, Peach Blow, or Peach Bloom Glass was made from 1860 to 1885 by the Mount Washington Glass Company of New Bedford, Mass. The surface often was given a dull satin finish by treating it with acid. The glassware was lined with white and plated with shaded colors of pink and blue glass.

Cristallo Glass was the typical clear, thin glass of the Venetians from the 1000's through the 1500's. Its beauty depended on the skill of the blower in shaping it. The glass has a slight grayness.

Crystal Glass is any clear and colorless glassware. The first crystal was made in England by George Ravenscroft in 1674. *Lead glass* and *flint glass* are kinds of crystal. *Rock crystal*, sometimes confused with crystal, is a colorless, clear form of quartz found in nature.

Firing Glasses were wineglasses made in England from 1740 to 1770. They received their name from their heavy bases, which were used to rap on the table in re-

Historic and Modern GLASSWARE



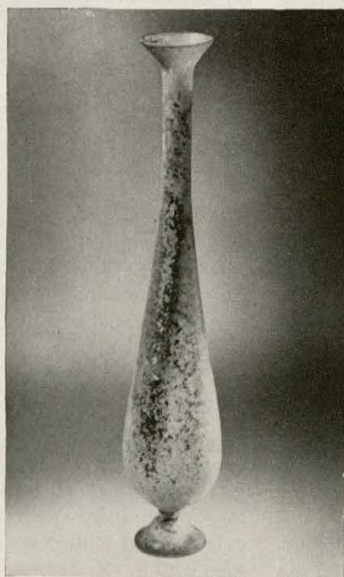
Egyptian Amphora,
about 1400 B.C.



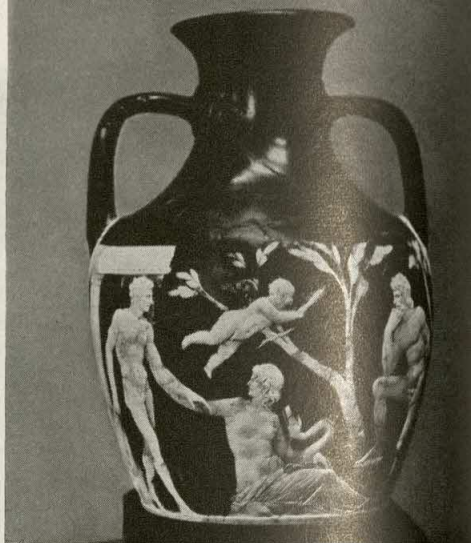
**Venetian Dragon Stem
Goblet,** about A.D. 1500



Athenian Cup,
about 475 B.C.



Syrian Bud Vase, about A.D. 200



The Portland Vase, made in Rome about
A.D. 70, is owned by the British Museum.



Syrian Cup, with
decorations of
enamel and gold,
about A.D. 1325



St. Mauritius Glass,
dated 1594,
Germany, possibly
Bohemia



Ravenscroft Goblet,
England,
about 1674



**Dutch Roemer,
or goblet,**
about 1650



Beilby Goblet,
England, 1700's



Stiegel Glass,
Pennsylvania,
late 1700's



Wistarberg Sugar Bowl,
New Jersey, late 1700's



Steuben Merry-Go-Round Bowl,
United States, middle 1900's

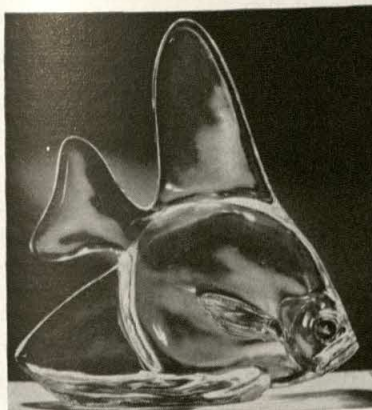


Gallé Vase,
France,
late 1800's

Corning Glass Works; Steuben Glass; U & U; Art
Institute of Chicago; Metropolitan Museum of Art



Lalique Vase,
France,
early 1900's



Steuben Decorative Fish, designed by Sid-
ney Waugh, United States, middle 1900's



Swedish Bowl, fireworks
design, middle 1900's

GLASS

sponse to a toast. They made a sound like guns firing. **Gimmal Flask** is a bottle with two or more heads, and separate compartments that can be used for different liquids.

Historical Glass is glass pressed with patterns to commemorate a famous person or a famous event.

Hobnail Glass, made during the 1880's, has patterns of raised bumps on the outside of the glassware.

Kew-Blas Glass is an iridescent glass made in the 1890's by W. S. Blake at the Union Glass Works of Somerville, Mass.

Lace Glass, or **Latticino**, is a Venetian glass made in the 1600's with fine lacelike patterns of white glass contained in the body of clear glass.

Lacy Glass was made by several companies in the United States in the early 1800's. The glassware was pressed with designs of a lacy appearance.

Mercury Glass, or **Silvered Glass**, was made in the United States during the 1800's. The glass was given a silvery appearance by pouring mercury between the thin inside and outside walls of a piece of glassware. The opening then was sealed to make the piece airtight.

Milk Glass, or **Opal Glass**, is an opaque, white glass widely used for tableware. One of the rarest types of milk glass is that which has a pattern of wheat sheaves pressed on the surface.

Millefiori Glass, which means *glass of a thousand flowers*, was first made in Venice in the early 1600's and still is produced. Tiny, colored glass rods are arranged in bundles, then fused together with heat. When the piece of glass is cut across, it has a design like that of many small flowers. This type of glassware often was used for paperweights.

Nailsea Glass was made in the 1700's and 1800's at Nailsea, England. The best-known type of Nailsea glassware was the *witch ball*. These hollow glass balls were lined with bright colors. They were hung in the windows by superstitious Englishmen to ward off witches.

Overlay Glass, made in the United States during the 1800's, has separate layers of contrasting colors.

Pairpoint Glass was made in New Bedford, Mass., during the late 1800's. It is particularly noted for a line of paperweights of blown glass, containing patterns of air bubbles which resemble teardrops.

Pattern Glass is glassware which has been pressed with decorative patterns.

Pomona Glass was patented in 1885 by Joseph Locke of Massachusetts. It is a tinted, clear glass which was blown into a mold. Then its surface was decorated with etching. A band of pale amber glass was applied to the unetched part.

Sandwich Glass was made by the Boston and Sandwich Glass Company, Sandwich, Mass., from 1825 to 1888. The company produced many kinds of glassware, but is best known for its pressed glass. Some persons mistakenly believe that all pressed glassware of the 1800's was Sandwich glass, but in reality many companies made pressed glass in large quantities.

Satin Glass, or **Mother-of-Pearl Glass**, was made by many companies in the late 1800's. Its surface has a satiny appearance. This appearance is caused by the

glass being treated with the fumes of hydrofluoric acid. **Stiegel Glass** was made by William Henry Stiegel from 1764 to 1773 at Manheim, Pa. He made good colorless glass and a wide variety of specially melted colors. He applied patterns to the glass by molding, enameling, and engraving.

Thread Glass has threads of different colored glass in the surface. These are usually on the necks of bottles, vases, and pitchers, and on the rims of plates.

Tiffany Favril Glass was made by Louis Comfort Tiffany in New York City from 1893 to 1933. It is an iridescent glass with rich colors from deep blue to purple and from green to yellow-gold. The decorative pieces, in addition, were decorated by carving through one layer of glass down to that of another color. The surface of the glass has a silky appearance.

Waterford Glass was made in Waterford, Ireland, from 1729 to 1851. This glassware has a slightly bluish-gray or smoky color. Thousands of tons of this glassware were shipped to the United States.

Wistarberg Glass, or **South Jersey Glass**. In 1739 Caspar Wistar built a glassworks in Salem County, New Jersey, which became the center of production for many small glass factories up to the middle of the 1800's. South Jersey glass is green or amber, of the type used in common bottles. The glassware is decorated with bands, swirls, and strings of applied blue or white glass.

Present-Day Art Glass

Many of the glass products of the 1800's could hardly be called artistic, even though many are collector's items. The trends toward extremely elaborate designs, the use of machinery, and high production seemed to stifle the creative urge.

In the past fifty years, glass has regained all its ancient distinction as a medium for creative expression. The revival began in France during the later 1800's. Emile Gallé, René Lalique, the brothers Daum, Maurice Marinot, and others began to make unusual, sometimes bizarre, glass, but glass which showed thought and imagination. Today's glassmakers have returned to methods which emphasize perfection of glass quality, classic beauty of shape, and sometimes the marvelous detail of copper wheel engraving.

In France, Daum and Baccarat, and in Sweden, Kosta and Orrefors are especially noted. In the United States, such companies as Steuben, Libbey, Fostoria, Fenton, Cambridge, Blenko, Imperial, Heisey, and Tiffin produce art glass.

Today, the most famous American art glass is made by the Steuben Glass Works. This company was founded in 1903 at Corning, N.Y., by Frederick Carder. He was an Englishman who had learned the art of glassmaking in his native country. Later, Corning Glass Works acquired the company and it is now known as Steuben Glass, Inc. The only glass used is a heavy lead crystal, transparent, almost free of imperfection, and possessing a beautiful sparkle. Most Steuben pieces are entirely handmade, are basically simple in shape, and are either completely unadorned or copper-wheel engraved. Many Steuben glassware pieces have been engraved with designs by such artists as Sidney B. Waugh and Marie Laurencin.

The President of the United States often has used pieces of fine glassware as gifts to the rulers of other

countries. See accompanying illustration of the Merry-Go-Round Bowl which President Truman presented to Princess Elizabeth (Elizabeth II) of Great Britain as a wedding gift.

G. J. PHILLIPS

See also COLONIAL LIFE IN AMERICA (Glassware); GLASS; STAINED GLASS.

GLASSWORT is an annual wild plant that belongs to the goosefoot family. It grows 4 to 20 inches high and has jointed, fleshy green stems that appear naked. The leaves are small and look like scales. The tiny flowers grow at the joints in groups of three. The *jointed glasswort* grows along the Pacific and Atlantic coasts.

Scientific Classification. The glasswort belongs to the family *Chenopodiaceae*. The jointed glasswort is genus *Sali-cornia*, species *europaea*.

PAUL G. STANDLEY

GLASTONBURY, GLASS *tun BER ih* (pop. 5,000), is an English town, famous in history and legend. It lies east of the Cornwall peninsula on the Plain of Somerset. According to tradition, Joseph of Arimathea founded the first Christian church in England at Glastonbury. The ruins of an abbey, founded at Glastonbury in the A.D. 900's, are of great interest to historians. For location, see GREAT BRITAIN (color map). See also ARTHUR, KING; JOSEPH OF ARIMATHEA.

GLAUBER'S, GLOW *burz*, **SALT** is a chemical compound of sodium sulfate and water. The large, transparent crystals lose their water and become a white powder when exposed to air. Many mineral waters, sea water, and the mineral thenardite contain Glauber's salt. It also forms part of a laxative called *Hunyadi Janos*. Glauber's salt has been used as a laxative since the 1600's. It was named for the German chemist Johann Rudolf Glauber, who first prepared it for use in medicine. See also SALTS.

AUSTIN EDWARD SMITH

GLAUCOMA, glaw *KOH muh*, is a disease of the eye that frequently occurs in older people. The eyeball becomes tense and hard. An increased pressure occurs inside the eyeball. Glaucoma causes disturbances in the flow of blood in the veins of the eye. The tension within the eyeball may destroy the delicate structures, and press the optic nerve backward. One kind of glaucoma may cause great pain in the eye, headache, and gradual loss of vision, while another variety is painless. The cause of glaucoma is not known. It often accompanies hardening of the arteries and high blood pressure, and may be hereditary. Glaucoma should be treated as soon as possible by a competent medical eye specialist. Doctors use such drugs as pilocarpine and eserine to treat early stages of glaucoma. Advanced cases require surgical operations.

HALLARD BEARD

GLAUCONITE, GLAW *koh night*, is a green mineral that looks like tiny flakes of mica. Deposits occur in New Jersey, Colorado, and Wisconsin. Chemically, it is a silicate of potassium and iron. But various other minerals and even volcanic glass form glauconite. At the present time, sea water is slowly forming glauconite. Therefore, scientists believe that the mineral deposits they find were made by oceans a long time ago. Nearly pure glauconite, called *greensand*, is used as a water softener.

RICHARD M. PEARL

GLAUCUS. See SCYLLA.

GLAUKE. See MEDEA.

GLAZE. See POTTERY; ENAMEL; PORCELAIN.

GLEANING, GLEEN *ing*, was the gathering of grain left by reapers in the fields. The laws of ancient Israel

GLENDOWER, OWEN

provided that some grain be left for the poor and the stranger (Lev. 19:10; 23:22).



H. Armstrong Roberts

Glee-Club Singing has been a favorite pastime for hundreds of years. Group singing helps youngsters develop their voices.

GLEE CLUB is a choral society organized for the purpose of singing ballads, part songs, and *glees* (unaccompanied songs for three or more solo voices). Glee clubs have become most popular among men in colleges and universities. They had little competition in college musical life until about 1920. Today, mixed-voice choirs have largely taken their place, although there has been a revival of glee clubs in many universities, including California, Dartmouth, Harvard, Illinois, Michigan, Stanford, and Yale. These groups sing music of fine quality, and often make alumni-sponsored tours with symphony orchestras. They illustrate the widespread opportunities for musical participation that glee clubs provide for students in public schools, colleges, and universities.

RAYMOND KENDALL

GLENDALE, Calif. (pop. 119,442; alt. 430 ft.), is an industrial center in the San Fernando Valley, about 15 miles northeast of Los Angeles. For location, see CALIFORNIA (color map). Its factories make roofing, cement, automobile and airplane parts, refrigerators, and pottery.

The site of Glendale was part of a land grant of 30,000 acres given by the king of Spain to the Verdugo family in 1784. They operated the grant for many years as a huge ranch. The Cahuenga Capitulation Treaty, which ended California's part in the Mexican War, was signed at the ranch on Jan. 13, 1847. Only 13 American families lived on the site of Glendale when the Southern Pacific Railroad reached it in 1883. Glendale was incorporated as a city in 1906. It has a council-manager government.

GEORGE SHAFTEL

GLENDOWER, OWEN. See WALES (Struggle Against the English).

JOHN H. GLENN

GLENN, JOHN HERSCHEL, JR. (1921-), was the first American to orbit the earth in space. He became a national hero on Feb. 20, 1962, when he circled the earth three times in less than five hours. Millions of persons watched on television as a giant Atlas rocket carried the space vehicle *Friendship 7* into the sky. People throughout the world heard Glenn's dramatic words from over 100 miles above the earth: "Oh, that view is tremendous!"

Glenn became one of America's most popular heroes since Charles A. Lindbergh made the first solo flight across the Atlantic Ocean in 1927. The astronaut kept his modesty, self-confidence, and quiet sense of humor throughout his dangerous flight. Afterwards, when referring to his feat, Glenn almost always said "we" instead of "I". He never forgot that it had taken thousands of persons to get him safely into space and back again.

The success of Glenn's flight helped overcome fears that the United States lagged far behind Russia in the race for space. During the previous year, two Russians made the first orbital flights around the earth. But the Russian achievements remained clouded in secrecy. The United States launched Glenn on his historic journey in full view of the world. The 40-year-old U.S. Marine lieutenant colonel became a symbol of America's hope for the future.

Glenn's Flight

The Countdown. Glenn began his great day at 2:20 A.M. when he was awakened for breakfast at Cape Canaveral, Fla. While he ate, scientists and engineers conducted the long *countdown*, the detailed pre-flight check of each piece of equipment. At 3 A.M., Glenn underwent a final physical examination. An hour and a half later, he squeezed into his skin-tight space suit.

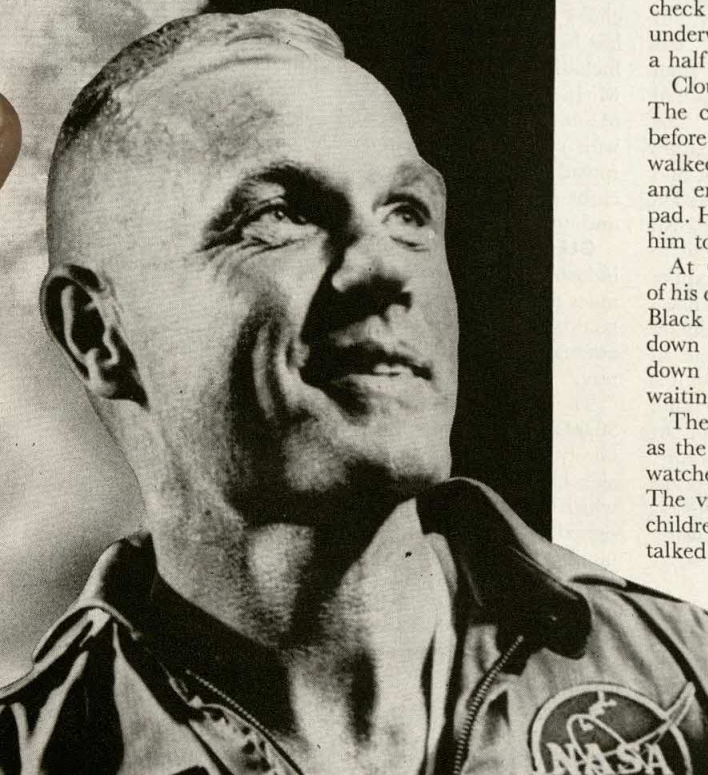
Cloudy skies threatened to postpone Glenn's flight. The countdown was stopped at 4:00 A.M., $3\frac{1}{2}$ hours before the scheduled launching. At 5:02 A.M., Glenn walked out of the hangar where he had spent the night, and entered the van that took him to the launching pad. He arrived at about 5:20 A.M. An elevator carried him to the top of the tall tower alongside the rocket.

At 6:03 A.M., Glenn slid through the tiny hatch of his capsule and settled himself in the cramped cabin. Black clouds still covered the sky. At 6:25, the countdown was resumed. At 7:53, workers finished bolting down the hatch cover on *Friendship 7*. Glenn sat alone, waiting.

The sky cleared about 8 A.M. The suspense mounted as the countdown continued. Millions of TV viewers watched the huge rocket, standing poised and ready. The viewers included Glenn's wife and two teen-age children in their home in Arlington, Va. The astronaut talked to them by phone as he sat waiting in the capsule.

The First American to Orbit the Earth, Marine test pilot John H. Glenn, smiles happily after his historic flight. The Project Mercury astronaut orbited around the earth three times on Feb. 20, 1962.

Wide World



The final part of the countdown began at 8:35 A.M. At 9:35, the countdown reached *T* (takeoff time) minus 10 (minutes). Glenn reported that he was "go," the astronauts' slang for "ready." Five more minutes of the countdown passed. Then came another "hold." Electrical trouble in a computer caused this final delay. At 9:42, the countdown resumed.

Glenn counted: "... six, five, four, three, two, one, zero." Then his dramatic words, "Lift-off. The clock is operating. We're under way." The rocket rose into the sky. Glenn began his flight into space at 9:47 A.M. (E.S.T.).

In Orbit. The launch went perfectly. The powerful rocket with the capsule mounted on its nose soared into space in a smooth, steady arc. Glenn radioed back routine technical reports indicating everything was going as planned.

About five minutes after the launch, the capsule separated from the rocket and went into orbit about 100 miles above the earth. The *Friendship 7* turned around in space as planned so that Glenn traveled backwards. He was completely weightless. As he headed out over the Atlantic, Glenn radioed back: "... Can see clear back a big cloud pattern away back across the cape (Canaveral). Beautiful sight."

Journey in Space. Glenn's flight lasted 4 hours and 56 minutes from launch to landing. He made three orbits of the earth, each one about an hour and a half long. He traveled a total ground distance of 83,450 statute miles. During the flight, the capsule's altitude ranged between 100.3 miles and 162.7 miles. After crossing the Atlantic Ocean, the *Friendship 7* zoomed over Africa, across the Indian Ocean, and over Australia. Then the capsule sped across the Pacific Ocean, over the West Coast of the United States, and back again above Florida. Eighteen radar tracking stations around the world kept a constant watch on Glenn. Because he was circling the earth, Glenn traveled from daylight to darkness and back again.

Inside the capsule, the astronaut performed his duties as a test pilot and radioed his reactions to earth. One of the most important questions to be answered by Glenn's flight was the effect on a human being of a long period of weightlessness. Glenn reported later: "... there just was no ill effect ... It was very pleasant ...". He also described how quickly he became adjusted to life without gravity. At one point he was holding a small camera. He let go of it for a moment to adjust a switch. Said Glenn: "... it just seemed perfectly natural rather than put the camera away. I just put it out in midair and let go of it." The camera, like Glenn, was weightless and simply floated in space.

Glenn ate with no trouble. Tubes held his food, which consisted of applesauce and a beef-vegetable mixture. The astronaut easily squirted the food into his mouth and swallowed it.

Trouble came near the end of the first orbit. At the time, the capsule was speeding over the tracking station at Guaymas, Mexico. Up to this point, the capsule's attitude (position in space) had been controlled automatically. *Friendship 7* began to swing to the right. Something had probably gone wrong. Glenn calmly switched from the automatic attitude control system to what the astronauts called the "fly-by-wire" system. Now he was holding the capsule in its proper position

in space. Glenn was probably the first human being to "fly" a space vehicle manually for any length of time. He "flew" *Friendship 7* for the rest of the flight.

During the second orbit, the Cape Canaveral ground control center received a warning signal that the space vehicle's heat shield was loose. Without the heat shield, the capsule would probably burn up when re-entering the earth's atmosphere. There was no way to tell whether the signal was true or false. Glenn was notified of the possible danger and changes were made in the re-entry procedures. It was decided not to jettison the retro-rockets during descent, but leave them in place on the heat shield. The retro-rocket pack could help hold the heat shield in place.

Back to Earth. At 2:20 P.M., 4½ hours after the launch, Glenn began his descent to earth. The capsule's retro-rockets fired, slowing the vehicle so that it would no longer orbit. *Friendship 7* plunged into the atmosphere.

Through the window, Glenn saw a bright orange glow. He said later: "It became apparent that something was tearing up on the heat shield end of the capsule because there were large pieces ... breaking off and falling off the edge of the capsule and coming back up past the window and were flaming very brightly. You could see the fire and the glow from them as they would come up back past the window ... there were some moments of doubt there as to whether the heat shield had been damaged and whether it might be tearing up itself. And this could have been a bad day all the way around if that had been the case."

At 2:30 P.M., the capsule's main parachute opened. Glenn was safe. From the capsule, the astronaut radioed happily: "Boy, that was a real fireball."

Five minutes later, the parachute lowered *Friendship 7* into the Atlantic Ocean, near the West Indies. The capsule landed at 2:43 P.M. Fifteen minutes later, the U.S. destroyer *Noa* picked up the capsule with Glenn still inside. At 3:24 P.M., the space hero crawled out of *Friendship 7*. While pulling himself out, Glenn suffered his only injury of the flight. He skinned his knuckles.

Later, Glenn learned that the flaming chunks of material he saw during the re-entry were parts of the retro-rocket pack, not the heat shield.

Glenn's Career

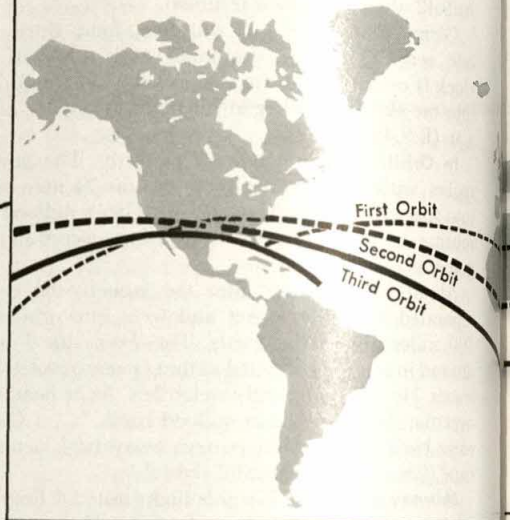
John Herschel Glenn, Jr., was born July 18, 1921, in Cambridge, Ohio. He grew up in New Concord, Ohio. His parents were still living in the town when their son became famous. In 1939, Glenn entered Muskingum College in New Concord. He left during his junior year to become a U.S. Marine Corps pilot in World War II. Soon after receiving his commission, Glenn married Anna Castor, his hometown sweetheart. They have two children, David and Carolyn Ann.

During World War II, Glenn became an ace pilot in the Pacific Theater. He flew 59 missions supporting ground troops. During the Korean War, Glenn flew 63 combat missions and shot down three communist planes. He earned a total of five Distinguished Flying Crosses and 19 Air Medals. After the Korean War, Glenn became a test pilot. The future astronaut made headlines in 1957 when he became the first man to fly faster than the speed of sound from Los Angeles to

UNITED
STATES

ASTRONAUT GLENN'S RIDE

The Track of *Friendship 7*...



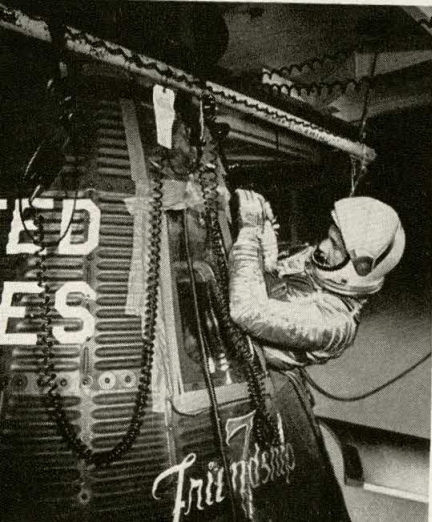
The Launch...

TIMETABLE OF A SPACE FLIGHT

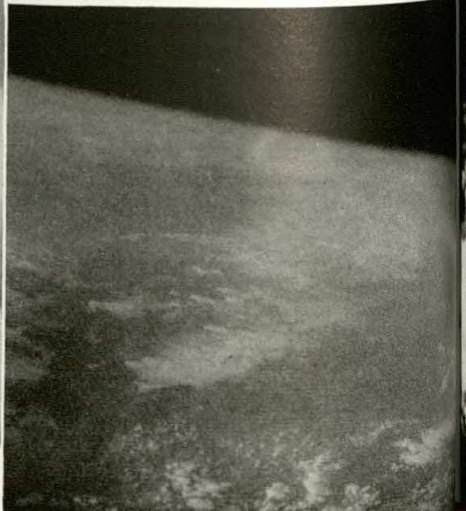
- 9:47 A.M.** *Friendship 7* lifts off from Cape Canaveral, Fla.
- 9:52 A.M.** *Friendship 7* goes into orbit 100 miles above the earth. Glenn is weightless.
- 10:09 A.M.** Glenn tastes his food sample while *Friendship 7* passes over Africa.
- 11:21 A.M.** *Friendship 7* begins its second orbit. Glenn reports difficulty with attitude control system, and shifts to manual control of the capsule.



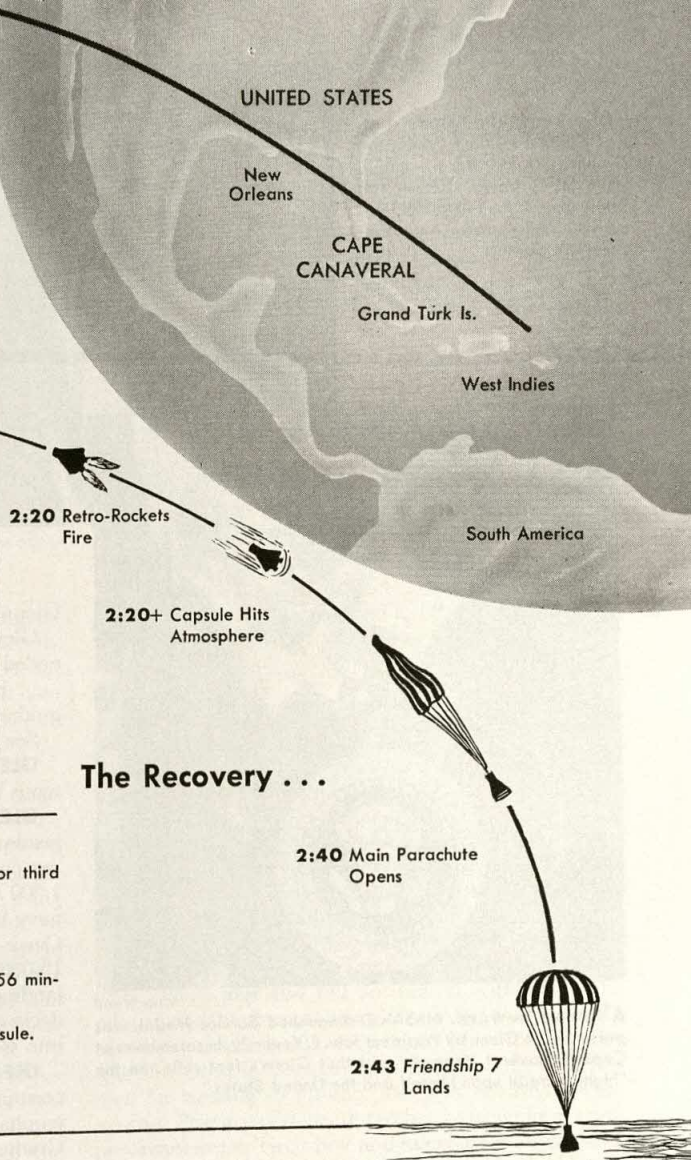
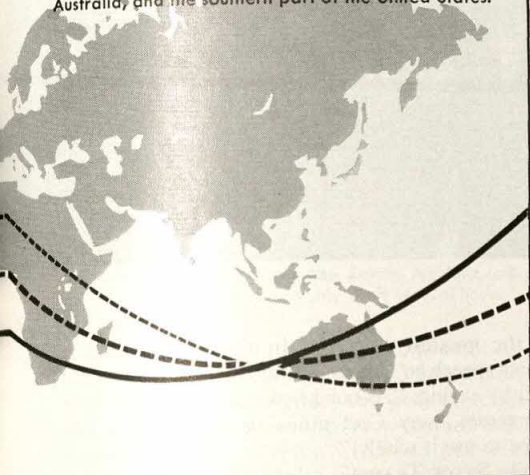
Countdown and Lift-Off. Dressed in his space suit, Glenn, below, squeezed into *Friendship 7*. His Atlas rocket, right, roared skyward swiftly and smoothly put the astronaut in orbit, above.



Glenn's View From Space. The astronaut took this photograph of the earth with a small hand camera. It clearly shows the curvature of the horizon and a layer of scattered clouds between the capsule and the earth.



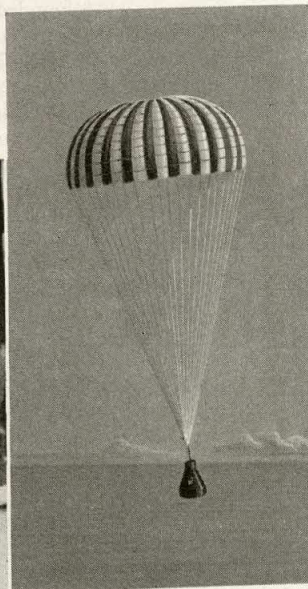
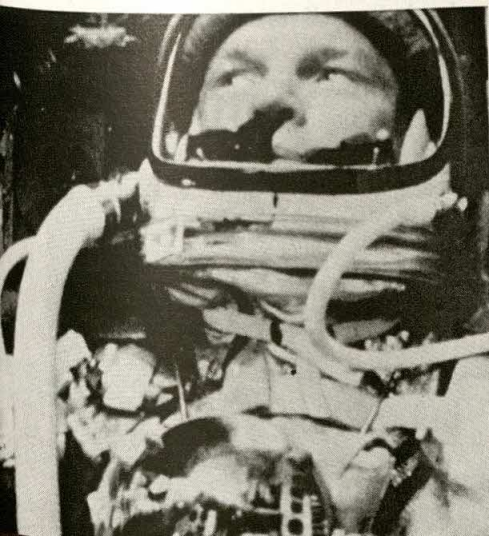
On this flat map, the paths of *Friendship 7* look like long, S-shaped curves. However, if you drew them on a globe they would appear as straight lines circling the earth. On each orbit, Glenn passed over Africa, Australia, and the southern part of the United States.



The Recovery . . .

- 12:50 P.M.** Project Mercury officials decide to try for third orbit despite control problems.
- 12:54 P.M.** *Friendship 7* begins third orbit.
- 2:20 P.M.** Retro-rockets fire. Descent begins.
- 2:43 P.M.** *Friendship 7* lands in water after 4 hours 56 minutes in flight.
- 3:01 P.M.** Destroyer *Noa* picks up Glenn's space capsule.
- 3:24 P.M.** Glenn comes out of *Friendship 7*.

Inside *Friendship 7*. Glenn performed his duties as a test pilot and "flew" the space capsule when the automatic control failed to operate. This picture of the astronaut was taken after the main parachute opened.



Back to Earth. Retro-rockets slowed the capsule and it began its long descent to earth, above. A parachute lowered the capsule to the sea, left, where it was picked up by destroyer *Noa*, below.

NASA; Wide World



Glenn and His Family chat with Vice-President Lyndon B. Johnson, right, after the flight. The group includes Glenn, his wife Anna, their two children David and Carolyn Ann, and Glenn's parents.



United Press Int.



Wide World

A Hero's Reward, NASA's Distinguished Service Medal, was presented to Glenn by President John F. Kennedy. In ceremonies at Cape Canaveral, Kennedy said that Glenn's feat reflected the "highest credit upon himself and the United States."

New York City. He made the trip in 3 hours 23 minutes.

In 1959, Glenn and six other men were chosen after a long series of tests from 110 test pilot volunteers for Project Mercury. This project had the goal of putting an American into space. Glenn, the oldest member of the group, served as "back-up pilot" in 1961 when fellow astronauts Alan B. Shepard, Jr., and Virgil I. Grissom made sub-orbital flights.

Religion played an important part in the space hero's life. Before Glenn, a Presbyterian, agreed to join Project Mercury, he asked his minister whether man had the moral right to explore space. The minister assured him that man did.

Four days after Glenn's flight, President John F. Kennedy flew to Cape Canaveral and presented the astronaut with the Distinguished Service Medal of the National Aeronautics and Space Administration. The next week, Glenn went to Washington, D.C. After a triumphal parade through the streets of the capital, Glenn received a rare honor. He addressed a joint session of Congress. Later in the week, New Yorkers gave

Glenn the greatest reception in their city's history.

Glenn's speech to Congress symbolized the man. He ended it by saying: "As our knowledge of this universe . . . increases, may God grant us the wisdom and guidance to use it wisely."

FORD EASTMAN

See also **SPACE TRAVEL**.

GLENNON, JOHN CARDINAL. See **MISSOURI** (Famous Missourians).

GLENNVIEW NAVAL AIR STATION, Ill., serves as headquarters of the naval and marine air reserve training commands of the United States. Covering about 1,500 acres, it lies 18 miles northwest of Chicago. The navy built the station in 1942 on the site of the former Curtis-Wright airport. During World War II, more than 15,000 naval and marine pilots qualified in carrier landings there. They flew from the station to the flight decks of two Lake Michigan passenger vessels converted into small aircraft carriers.

JOHN H. THOMPSON

GLENNVILLE STATE COLLEGE is a state-controlled coeducational school at Glennville, W.Va. The school emphasizes teacher education and rural education. Graduates receive A.B. or B.S. degrees. The college was founded in 1872. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

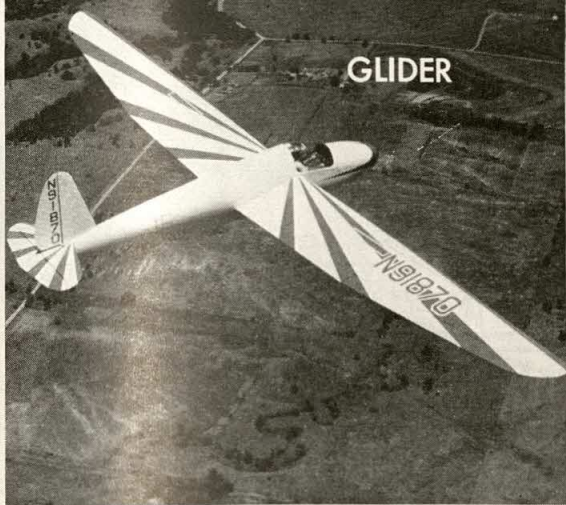
GLICK, GEORGE WASHINGTON (1827-1911), was the first Democrat to be elected governor of Kansas. Born in Ohio, he studied law in the office of Rutherford B. Hayes and practiced in Ohio from 1850 to 1858, when he moved to Atchison, Kans. He was an attorney for the Union Pacific Railroad, served eight terms in the state legislature, and was governor of Kansas from 1883 to 1885. Later, he was a member of the state board of agriculture. In 1914, Kansas placed a statue of Glick in Statuary Hall, Washington, D.C.

W. B. HESSELTINE

GLIDDEN, CARLOS (1834-1877), an American inventor, is best known for his share in the invention of the Remington typewriter. He met his co-inventors, C. L. Sholes and Samuel Soule, while in Milwaukee working on the development of a spading machine for agricultural use. In 1868, they patented the typewriter. In 1874, they sold it to E. Remington and Sons, who marketed it successfully (see **TYPEWRITER**). Glidden was born in Scioto, Ohio.

ROBERT P. MULTHAU

GLIDDEN, JOSEPH F. See **BARBED WIRE**.



Hans Groenhoff

Gliders Soar High Above the Earth. Airplane controls allow the pilot to use air currents to stay aloft several hours.

GLIDER is an airplane which flies without an engine. It is man's closest approach to flying like a bird, silently and without effort. A glider can *glide* downhill on air, like a sled coasting down a snow-covered hill. It also can *soar* upward on rising wind and heat currents in the air. Flying in a glider is somewhat like riding up and down on an invisible roller coaster.

People used to think that gliding and soaring could be done only in hilly country, where the wind blowing against the hills caused up-currents. But in the 1920's men found that rising air currents also develop over flat ground that is warmed by the sun. There also are rising currents in large, puffy white *cumulus* clouds and in *thunderhead* clouds. Today men can glide and soar in gliders in coastal areas, over mountains, and in the Plains States. In fact, gliders are flown anywhere that anyone has the desire for engineless, heavier-than-air flight.

A glider is controlled in flight like an airplane. It has elevators, ailerons, and a rudder which the pilot operates by moving a control stick and rudder pedals in the cockpit. (See **AIRPLANE**.) Gliders carry many of the same instruments as airplanes, such as altimeters, which show height, and air-speed indicators. (See **AIRCRAFT INSTRUMENTS**.) Most gliders also carry an instrument called a *sensitive variometer*, which tells the pilot the rate at which air is carrying the glider up or down, in units

GLIDER

of 100 feet a minute. This helps him to have complete control of his glider at all times.

Most gliders are launched into the air from hilltops, or by being towed by a power winch, an automobile, or an airplane. Other gliders carry an *auxiliary power unit* consisting of a small engine and propeller that powers the glider until it reaches favorable air currents. The power unit is then folded away to reduce air resistance while gliding and soaring.

Some gliders are built with a wooden framework for the body and wings, which is covered with cloth and painted. They also may be built entirely of lightweight metal. Gliders usually have a single-wheel landing gear. It is centered under the body.

Anyone in the United States who is healthy and at least 14 years old can learn to fly a glider. He must first obtain a *student glider pilot rating* from the Federal Aviation Agency. To earn a *private glider pilot rating* from the FAA, the student must complete 100 gliding flights and pass FAA tests to prove his skill. The pilot must be 18 years old before he can obtain a *commercial glider pilot rating*.

Kinds of Gliders

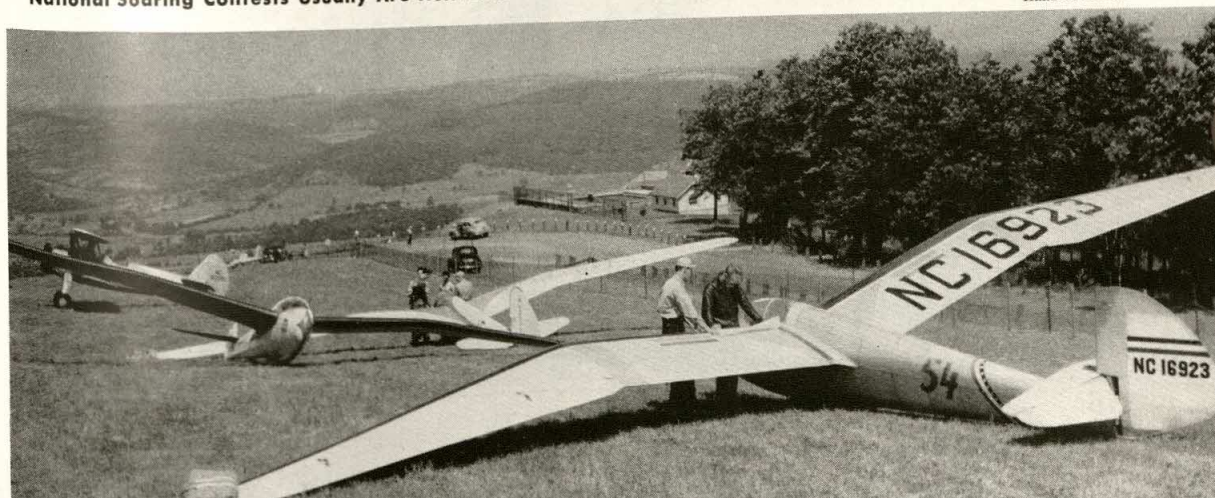
In the early days of glider flying there were many types of gliders. They had one, two, three, or more wings. Inventors arranged wings in many different ways as they tested their ideas about flying. Today most gliders are *monoplanes*, having one wing extending from each side of the body. The wing extends across the top of the body of a *high-wing glider*. Wings on *mid-wing gliders* extend from about halfway down the body.

The Primary Glider is the simplest, lightest, and least expensive kind of glider. The body is an open framework. The wings and tail are braced with wire. The pilot sits at the front of the glider in an open seat. In case of a crash he has no protection. This kind of glider was developed in Germany in the early 1920's. It was used for training in gliding, and was not suitable for soaring. Primary gliders are too heavy to perform complex maneuvers. Their best and safest use is for coasting downhill. Primary gliders are seldom used in the United States. They have been replaced by utility and two-seat training gliders which are towed by a power winch or an automobile.

The Utility Glider has an enclosed body. Its wing has

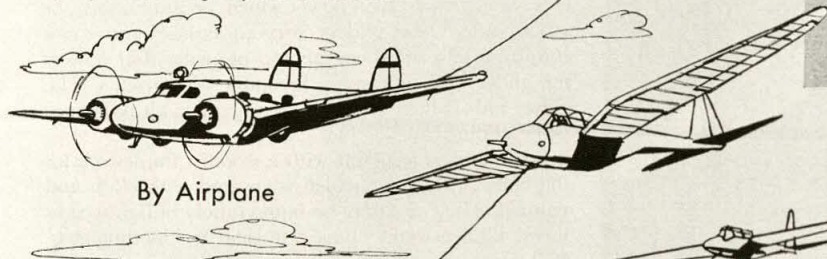
National Soaring Contests Usually Are Held Each Year at Elmira, N.Y., the "Glider Capital of the United States."

Hans Groenhoff

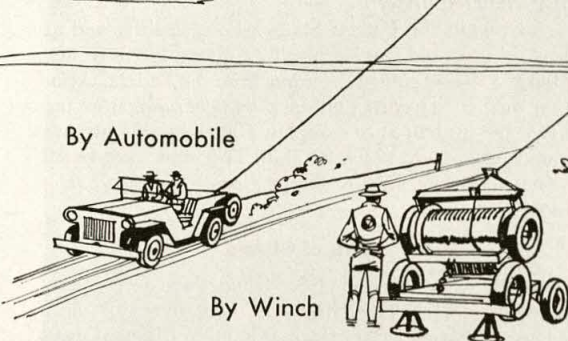


HOW GLIDERS ARE LAUNCHED

Gliders sometimes are launched from hilltops by means of elastic cords that act like giant slingshots. They also can be pulled into the air from level ground like kites, at the end of 250- to 300-foot lines towed by automobiles, airplanes, or engine-powered winches.



By Airplane

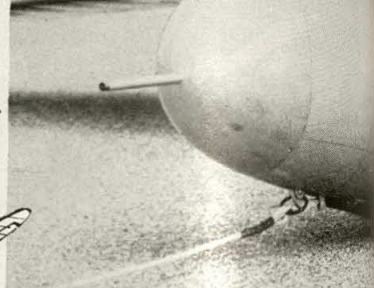


By Automobile

By Winch



From Hills



Hans Groenloft

Towline Connection in nose of glider can be released by pilot in cockpit to drop towline and soar freely.

Adapted courtesy Soaring Society of America, Inc.

better lifting power than that of a primary glider. Utility gliders are often built as two-seaters. The wings are braced to the body with streamlined struts. This glider is strongly built, and gives the occupants great protection. It can be used for training in soaring, as well as for primary training in gliding.

Sailplanes, or *soaring planes*, make the best use of air currents. They are specially designed gliders with long, slender wings and smooth, streamlined bodies. They can glide at very flat angles. Some lose only one foot of altitude for 35 to 40 feet of distance covered. These sailplanes have low *sinking speeds*. Sinking speed is the ability to lose altitude slowly while gliding. Some

sink more slowly than two feet a second, which is slower than a soap bubble or a thistledown coming down in still air!

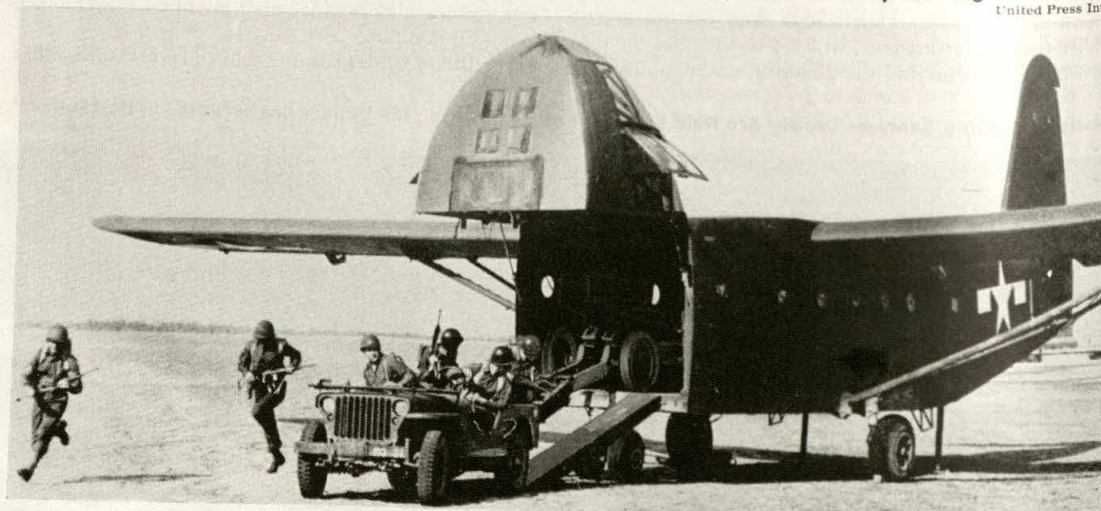
How Gliders Are Used

In Sport. Gliding and soaring clubs have become popular in many parts of the world. People gather in these clubs to build and fly gliders for fun. They compete to see who can fly the farthest or highest, and who can stay in the air the longest.

Gliding as a sport began in 1920 in Germany, where the first glider contests were held on Wasserkuppe Mountain. In the United States, the first National

Giant U.S. Glider Built of Plywood in World War II Carried 30 Infantrymen, or a Jeep and Light Field Gun.

United Press Int.



Soaring Contest was held at Elmira, N.Y., in the summer of 1930. National Soaring Contests have been held yearly since then, except during World War II. These meets are sponsored by the Soaring Society of America, which is a national organization devoted to gliding and soaring. The Soaring Society of America issues gliding and soaring lapel buttons that show the experience of the pilot. The first World Championship Soaring Competition was held in Sweden in 1950.

In Flight Training. Gliding is an excellent means of giving an airplane pilot his first instruction in how to fly. Because a glider has no engine, the pilot has fewer things to think about while flying.

In the early days of gliding in Germany, beginners were placed in primary-training gliders. They were told how to handle the controls and were then launched by a rubber-cord slingshot down a gently sloping hill.

In the United States, the automobile tow method of training was developed. The glider is towed behind an automobile on a short towline at low speed. The student learns to balance the glider on its single wheel. When he has learned to do this, the glider is towed at a higher speed. Then the glider takes off and flies along behind the automobile at an altitude of two to three feet. As the pilot learns more, he is allowed to go still higher. Then he releases the towline and glides back down to the ground. In this type of training, the student flies alone at all times. Pilot training also is now done in two-seat gliders with instructors.

In most European countries, glider flying is a required part of airplane pilot training.

In Research. From the earliest days of aviation, the glider has been used as a tool for the development of

airplanes, because flying without an engine requires careful design. Gliders can carry delicate instruments to study the air currents, because they fly more slowly and with less vibration than airplanes. Basic studies on means of increasing the lift of wings, particularly at low speeds, are being carried out by means of gliders. Gliders also have been used to study what happens inside thunderstorm clouds.

History of the Glider

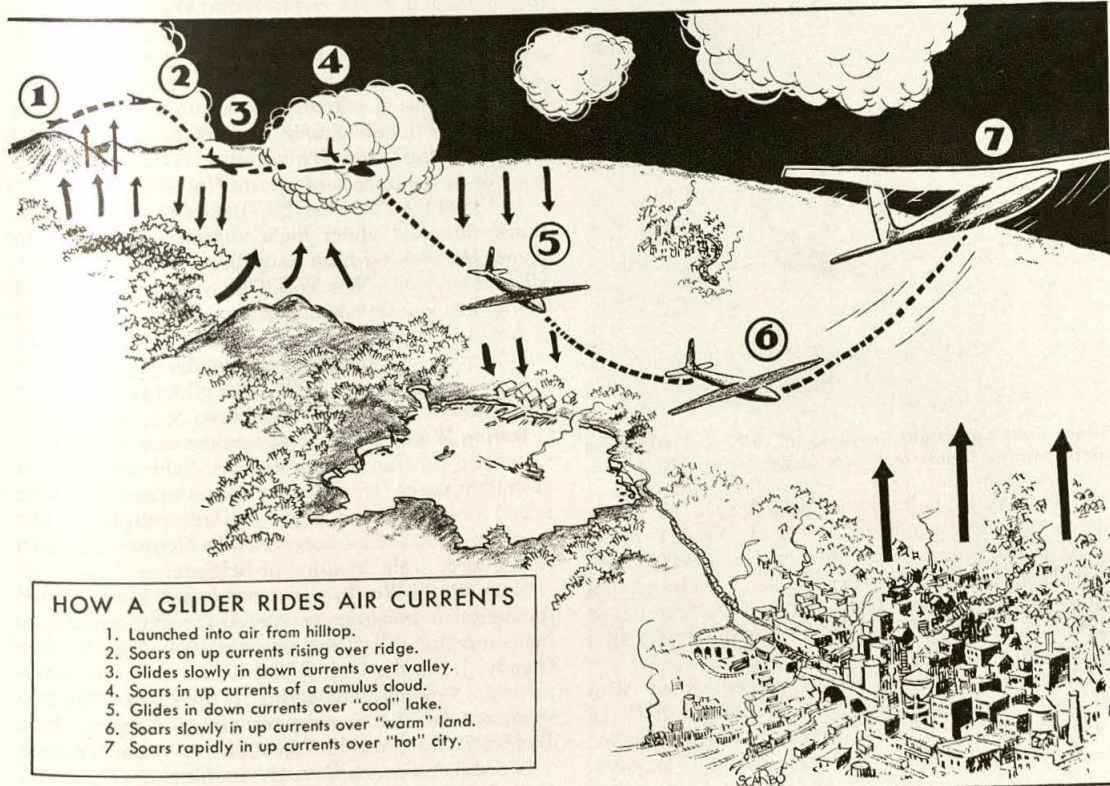
Early Experiments. Man's first successful flights with wings were made in gliders. In 1678 a French locksmith named Besnier claimed to have flown from the top of his house, using paddlelike wings on his shoulders and feet. But Besnier's claim seems unlikely.

Sir George Cayley (1773-1857) built the first biplane glider in England in 1810. It had a wing surface of 300 square feet, and glided a few yards, carrying a man. It was reported that he built a second and larger glider which carried his coachman a distance of 900 feet before it crashed. The coachman was not injured, but he was so frightened that he quit his job. Cayley then stopped building gliders.

About 1854 a French sea captain, Jean-Marie le Bris, built a glider with a wing span of 23 feet and shaped like an albatross. For a picture showing this comparison, see *BIRD* (Wings in Flight [Glider Wings]). Le Bris claimed to have flown 300 feet high and one eighth of a mile, but there is no proof that he did.

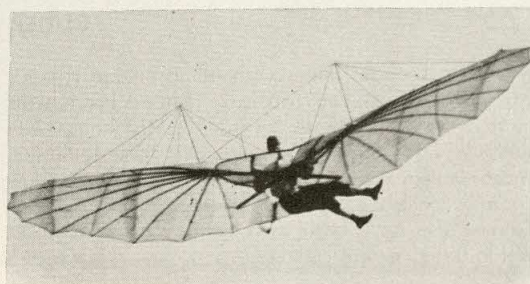
Pioneer Gliders. Otto Lilienthal (1848-1896) of Germany was the first to develop and fly successful gliders.

United Press Int.



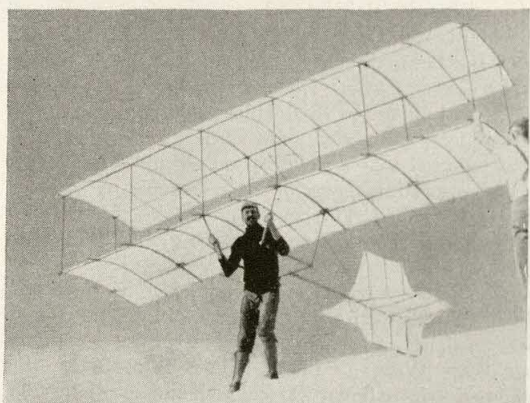
HOW A GLIDER RIDES AIR CURRENTS

1. Launched into air from hilltop.
2. Soars on up currents rising over ridge.
3. Glides slowly in down currents over valley.
4. Soars in up currents of a cumulus cloud.
5. Glides in down currents over "cool" lake.
6. Soars slowly in up currents over "warm" land.
7. Soars rapidly in up currents over "hot" city.



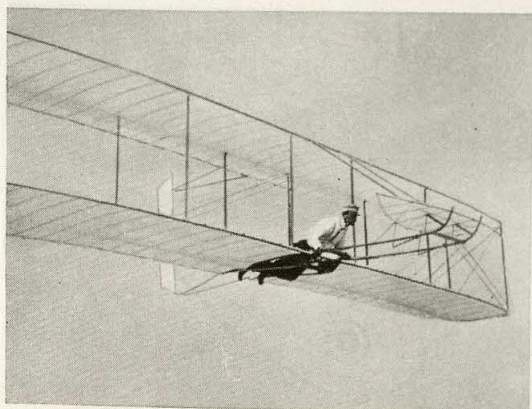
U.S. National Air Museum, Smithsonian Institution

First Successful Glider was made by Otto Lilienthal of Germany. He steered it by swinging his body from side to side.



U.S. National Air Museum, Smithsonian Institution

Biplane Glider, built by Octave Chanute and flown by A. M. Herring in 1898, developed from design of a box kite.



Brown Bros.

Glider Built by Wright Brothers in 1902 had more lifting power and could glide at smaller angles than earlier gliders.

Beginning in 1891, he made more than 2,000 glider flights. Lilienthal was killed in a glider crash in 1896. In Great Britain, Percy Pilcher (1866-1899) built several successful gliders before he, too, was killed in a crash. Octave Chanute (1832-1910) of Chicago developed a number of control devices in the 1890's that resembled rudders and ailerons.

Wilbur and Orville Wright experimented with gliders at Kitty Hawk, N.C., from 1900 to 1902. In 1911, Orville Wright made what was probably the first soaring flight in a glider. It lasted almost 10 minutes.

John J. Montgomery, a professor at Santa Clara

GLIDER WORLD RECORDS

Altitude

HEIGHT (FT.)	YEAR	PILOT	COUNTRY
8,494	1929	Robert Kronfeld	Germany
22,434	1938	Erwin Ziller	Germany
42,100	1950	Walter S. Ivans, Jr.	U.S.A.
44,255	1952	Laurence E. Edgar	U.S.A.

Nonstop Straight Line Distance

MILES	YEAR	PILOT	COUNTRY
102	1930	Robert Kronfeld	Germany
233	1934	Heinrich Dittmar	Germany
405	1937	Victor Rastorgoueff	Russia
535	1951	Richard H. Johnson	U.S.A.

Distance to Predetermined Point

MILES	YEAR	PILOT	COUNTRY
421	1956	Rene Fanteilles	France

Distance to Predetermined Point and Return

MILES	YEAR	PILOT	COUNTRY
331.6	1959	Ludwik Misiek	Poland

Speed for Measured Triangular Course

DISTANCE	MPH	YEAR	PILOT	COUNTRY
100 km.	66.51	1959	Richard E. Schreder	U.S.A.
200 km.	67.01	1959	Richard E. Schreder	U.S.A.
300 km.	60.18	1959	Richard E. Schreder	U.S.A.

College in California, began gliding experiments as early as 1884. In 1905, Montgomery and one of his pilots, Daniel Maloney, made numerous flights in which the glider was lifted several thousand feet by a balloon, and then released to glide back to earth.

After World War I. The development of the powered airplane in the early 1900's caused people to lose interest in gliders for a number of years. Gliding was revived by the Germans after the end of World War I. The Treaty of Versailles forbade the Germans to build airplanes, and so they had to do their flying in gliders.

Cloud soaring was first begun in Germany in 1928, using the upward currents under cumulus clouds and in the face of thunderclouds. By 1939 there were 186,000 German glider pilots. These pilots became the backbone of the German air force in World War II.

In 1930 Frank Hawks (1897-1938) completed the first transcontinental glider flight, towed behind an airplane. He took off from San Diego, Calif., on March 29, and landed in New York City on April 6. The total flying time was 36 hours 47 minutes.

American glider pilot Ralph S. Barnaby (1893-), made the first successful glider flight from an airship on January 31, 1930. The glider was launched from the *Los Angeles* over Lakehurst, N.J.

During World War II, large gliders were built. They were used for transporting soldiers, field artillery, and even light tanks. These gliders did no soaring, but were towed from place to place by large airplanes, like freight cars behind locomotives. The Germans first used such gliders in the invasion of Belgium.

Since World War II, glider enthusiasts have devoted themselves to breaking records. At the sixth world soaring competition, held in France in 1956, Paul B. MacCready, Jr., of the United States won the world championship. Gliding and soaring in the United States is sponsored by the Soaring Society of America, Inc., Box 66071, Los Angeles 66, Calif.

RALPH S. BARNABY

See also AVIATION; CAYLEY, SIR GEORGE; CHANUTE, OCTAVE; WRIGHT BROTHERS.

GLINKA, MIKHAIL IVANOVICH (1804-1857), was a Russian composer. His operas, *A Life for the Czar* (1836) and *Ruslan and Ludmilla* (1842), mark the beginning of musical nationalism in Russia. He was attracted to Russian folk music and had a strong liking for the poems of Alexander Pushkin, which gave his operas a recognizable Russian flavor.

Glinka called attention to Russian folk music, which influenced the development of music in the 1800's. Glinka was born in Smolensk. He studied in St. Petersburg (now Leningrad) and in Italy, France, Germany, and Spain.

THEODORE M. FINNEY

GLIOMA, *gly OH muh*, is any tumor formed by neuroglia cells. The *neuroglia* are the cells that make up the special supportive tissues of the nerves. These tumors usually affect the tissues of the brain and the spinal cord. There are many different kinds of gliomas and they are usually named for the specific tissues they affect. See also **TUMOR**.

GLITTERTIND. See **NORWAY** (Land Regions).

GLOBE is a map that has been pasted or printed on a hollow sphere. Most *terrestrial globes*, or globes of the earth, consist of a series of triangular or tapering strips of paper called *gores*, which have been pasted onto a sphere. A world map is printed on the gores.

Globes have many uses. They are used widely in geography and are seen in many classrooms and libraries. They are also helpful in planning air and sea routes and in establishing radio communications.

Only a globe can give a correct picture of the earth as a whole. Because the surface of a globe is rounded like the earth's surface, a globe represents all parts of the earth's surface true to scale. Distances, areas, and directions can be observed without the distortion caused by projections used for flat maps. The proportions and positions of land features and oceans in relation to each other are seen on a globe exactly as they are on the earth. The shortest distance between two points on the earth or a globe is called a *great circle*. Navigators make use of the great-circle route in planning ship and air lanes. A great circle can be measured directly on a globe (see **GREAT-CIRCLE ROUTE**).

Globes may be mounted on a center axis to show how the earth rotates, or they may be placed in a cradle without attachment. With special accessories, many different relationships between the earth and the sun can be demonstrated on a globe. Such relationships include the length of daylight, time differences, and satellite paths.

Martin Behaim made one of the first terrestrial globes in Nuremberg, Germany, in 1492. Few globes are more than 18 inches in diameter. The Langlois Globe, produced in France in 1824, measures 128 feet in diameter, and is probably the largest globe in the world. Other large globes which measure from 10 to 30 feet in diameter have been made for newspapers and museums. A globe with a diameter of 30 feet is displayed in the Christian Science Building in Boston, Mass. Spectators stand inside the globe to see the outlines of the earth's surface.

A globe which is a map of the heavens is called a *celestial globe*. The earth itself is a great sphere, and is often referred to as *the globe*.

E. B. ESPENSHADE

See also **ANTIPODES**; **HEMISPHERE**; **MAP** (General Reference Maps).



H. Armstrong Roberts

Studying a Globe is the best way for students to get an understanding of basic world geography. Only a globe can show all parts of the earth true to scale. Directions and distances can be given accurately, and ocean routes can be measured easily.

The First Globes Made in the United States appeared in 1810. James Wilson, a Vermont farmer and copper engraver, made them in his workshop, below. He engraved his maps with such accuracy that when they were cut apart and pasted on hollow wooden spheres, they fitted perfectly. Many of the methods followed by Wilson are still used in the map-making industry.

Natl. Life Insurance Co.



GLOBE

GLOBE, Ariz. (pop. 6,217; alt. 3,510 ft.), the center of a copper-mining district, is also a shipping point for livestock. Globe lies 88 miles east of Phoenix, near the San Carlos reservation for Apache Indians (see ARIZONA [map]). The city is at the foot of the Pinal Mountains, between Theodore Roosevelt and Coolidge dams. Tonto National Monument and the Salt River Canyon lie nearby. Globe was settled in 1873, and has a council-manager government.

ALICE B. GOOD

GLOBE AMARANTH. See BACHELOR'S-BUTTON; EVERLASTING FLOWER.

GLOBE THEATRE was an open-air public playhouse built in 1599 in Southwark, a suburb of London. It gained fame as the home of William Shakespeare's theatrical company, the Lord Chamberlain's Men. Most plays written by Shakespeare after 1599 were probably performed there. The Globe burned in 1613, and was rebuilt in 1614. But it was finally pulled down in 1644. See also SHAKESPEARE, WILLIAM (picture, Stage and Theater).

GLOBULIN, *GLAHLB yoo lihnl*, is a protein component of the watery, or *plasma*, part of the blood. Scientists classify globulin as alpha, beta, and gamma globulin. Each group, particularly gamma globulin, contains materials called *antibodies*, which give protection against specific infections (see ANTIBODY). When additional antibodies are needed, as during infections, the gamma globulin content increases.

WILLIAM DAMESHEK

See also GAMMA GLOBULIN.

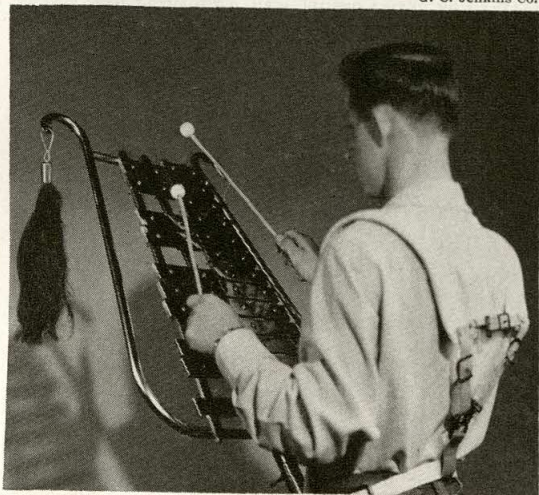
GLOCKENSPIEL, *GLOCK un speel*, is a percussion instrument made up of a series of steel bars, played with hard mallets. Glockenspiels sound like high-pitched bells. *Glockenspiel* means *bell-play* in German.

The glockenspiel probably developed from the tuned chime bells, used by monks as early as A.D. 800. Historians believe that Dutch bellmakers of the early 1700's substituted metal bars for the bells. These instruments then became glockenspiels. A type known as the *bell-lyra* has bars on a lyre-shaped frame.

Some organs have a stop called a *glockenspiel*. It consists of bells, rods, or tubes, sounded by hammer action.

The Glockenspiel Is Used in Bands and Orchestras.

G. C. Jenkins Co.



GLORIOUS REVOLUTION. See ENGLAND (The Restoration).

GLOSSARY is a list of definitions of special words, such as those used in the sciences and trades. The word comes from the Greek *glossa*, meaning the *tongue*. A glossary usually appears at the end of a book, a chapter, or an article, and explains terms used in the text.

GLOTTIS. See LARYNX.

GLOUCESTER, *GLAHS tur* (pop. 67,300; alt. 100 ft.), is an industrial and shipping center near the mouth of the River Severn, in west-central England. Its magnificent cathedral was built in the 1000's, and the 225-foot tower in the 1450's. Robert Raikes, a publisher, founded the world's first Sunday school at Gloucester in 1780. The city dates from early Roman times.



H. Armstrong Roberts

Gloucester, Mass., a leading fishing port for over 300 years, is the home port for a large fleet of fishing vessels.

GLOUCESTER, Mass. (pop. 25,789; alt. 11 ft.), has been an important fishing center since colonial days. Gloucester lies in northeastern Massachusetts near the tip of Cape Ann, about 30 miles from Boston (see MASSACHUSETTS [color map]). Gloucester fishermen are noted for their skill and daring. A striking statue, *Fishermen's Memorial*, overlooks the small, well-protected harbor. The city constructed it as a tribute to the many Gloucestermen who have lost their lives in fishing. The processing of fish and manufacture of fish products rank as the chief industries. The city also produces men's and boy's winter coats and jackets. Gloucester is a famous summer resort. It was settled in 1623 and incorporated as a city in 1873. See also MASSACHUSETTS (color picture).

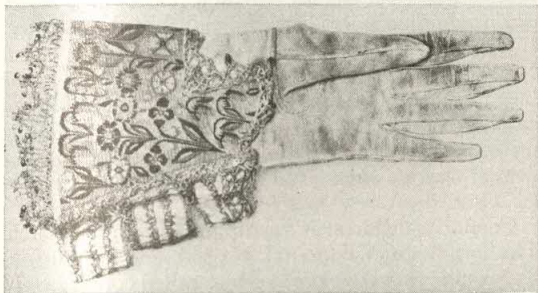
WILLIAM J. REID

GLOVES

Gloves have been worn since prehistoric times to protect the hands, and as ornamentation and a sign of rank.

Silk and Silver Tapestry Work decorates the cuff of a fancy leather glove made in England in the 1500's.

Metropolitan Museum of Art



GLOVE is a protective or decorative covering for the hand. It has a separate sheath for each finger. The word *glove* comes from the Anglo-Saxon *glof*, which means *palm of the hand*.

Prehistoric cave dwellers in France wore crude gloves. The ancient Greeks wore gloves to protect their hands when they did rough work. The Romans used them as ornaments and as a sign of rank. During the Middle Ages, gloves were expensive, and only the wealthy wore them. Knights often fastened ladies' gloves to their helmets to show love or devotion. Gloves were also used as a sign of challenge. A challenger threw down his glove, and the person who accepted the invitation to fight picked it up. This was called *throwing down the gauntlet*. In Elizabethan England, gloves were highly valued, and glovemakers were important men. Shakespeare's father was a glovemaker.

Gloves today are made of many different materials, such as leather, silk, fur, cotton, rubber, canvas, and wool. The United States leads the world in the production of men's gloves. New York is the center of the American glovemaking industry. The industry began in Fulton County, New York, in 1760, when glovemakers came from Connecticut to settle on land granted to them by Sir William Johnson, an Irish general. Fulton County now produces half the leather gloves made in the United States. Gloversville, in Fulton County, makes one out of every three gloves manufactured in the United States.

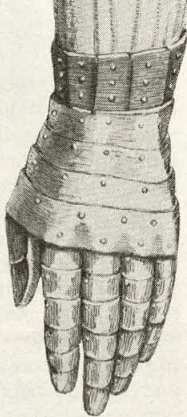
Fine women's gloves are made chiefly in France. In Canada, glovemaking factories are situated in Ontario and Quebec.

WILLIAM H. DOOLEY

See also GAUNTLET.

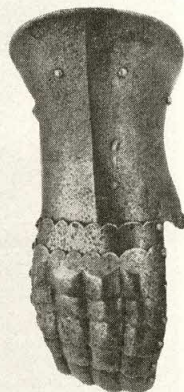
GLOVER, JOHN. See REVOLUTIONARY WAR IN AMERICA (Princeton and Trenton).

GLOWWORM. See FIREFLY.

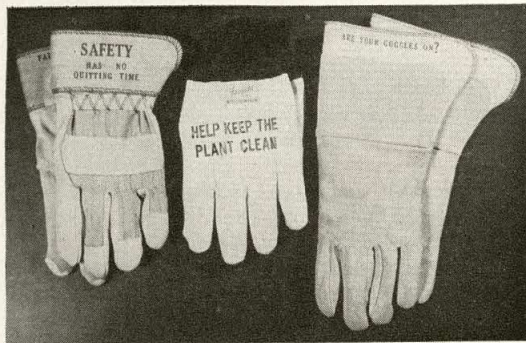


Knights of the Middle Ages wore armored gauntlets, left. These were heavy leather gloves covered with many little plates of iron.

The German Mitten-Type Gauntlet, right, dates from the 1400's. The individual fingers could not be clenched or extended at will.



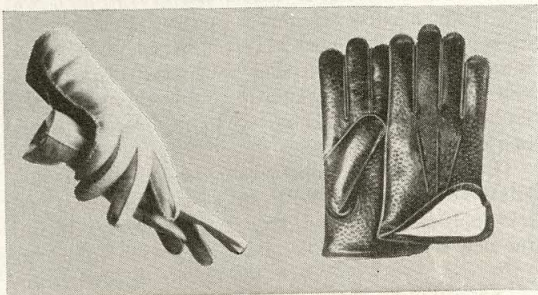
The George F. Harding Museum, Chicago



Fairfield Glove Co.

Canvas and Leather Work Gloves worn by industrial workers, above, often have safety slogans printed on them. Ladies' and men's dress gloves, below, may be made of leather or other materials. Fine gloves made in France are still hand-sewn.

Reprinted from *Glamour* © 1958, The Condé Nast Publications, Inc.; Wells Lamont Corp.



The Modern Glove Industry uses specially designed sewing machines to sew together the strangely shaped parts of gloves.

Union Special Machine Co.





Cornelia Clarke

Gloxinia is a Popular Greenhouse Plant. The flowers are shaped like a bell or trumpet, and are white, red, or purple. Some of the blossoms have streaks or spots of darker colors.

GLOXINIA, *glahk SIN ih uh*, is a plant remarkable for its richly colored velvety leaves and large bell-shaped flowers. Gloxinia is native to tropical America, but is widely cultivated as a house plant and in greenhouses. It requires rich, drained soil and careful attention. The plants prefer a moist atmosphere. Gloxinia can be grown from tubers, seeds, or leaf cuttings.

Scientific Classification. Gloxinia belongs to the family *Gesneriaceae*. It is classified as genus *Sinningia*, species *speciosa*.

ROBERT W. SCHERY

GLUCINUM. See BERYLLIUM.

GLUCK, ALMA (1884-1938), was a well-known concert and operatic soprano. She was born in Bucharest, Romania, and came to the United States as a child. She was married to Efrem Zimbalist, a famous violinist. Her daughter, Marcia Davenport, wrote *Of Lena Geyer* (1936), the story of an opera singer.

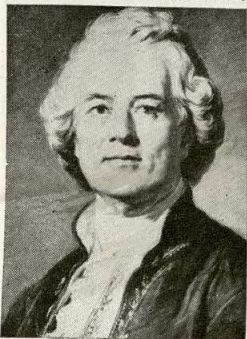
DANIEL A. HARRIS

GLUCK, CHRISTOPH WILLIBALD (1714-1787), was one of the pioneer reformers of opera. Gluck tried to make all parts of opera serve the drama, rather than interrupt the action to allow singers to display their voices or burden the story with contrived emotions. He set out these views in the preface to his *Alceste*, published in 1769.

Gluck's first reform opera was *Orfeo ed Euridice* (1762). His others included *Alceste*, *Iphigénie en Aulide* (1774), and *Iphigénie en Tauride* (1779). In spite of early criticism, the new style came to be praised. It greatly influenced the operas of Mozart and Wagner.

Christoph W. Gluck

Ewing Galloway



Gluck was born at Erasbach, Bavaria, and studied in Prague, Vienna, and Milan. From Giovanni Sammartini, a composer and teacher, he learned to write operas in a conventional style, and became highly successful. He later worked in Vienna and studied French opera, which encouraged him to express deep feelings in his operas.

PERCY M. YOUNG

GLUCOSE, *GLOO kohs* (chemical formula, $C_6H_{12}O_6$), is a white, crystalline sugar, about half as sweet as cane sugar. It is also called dextrose and grape sugar. Glucose forms in the juice of grapes and several other sweet fruits. Seeds, leaves, roots, flowers, honey, and the bodies of men and animals also contain glucose.

Glucose is a simple sugar that does not have to be digested when taken into the body. Molecules, or particles, of glucose pass directly through the walls of the small intestine into the blood stream. Glucose carried in the blood oxidizes to supply heat and energy to all the tissues of the body. Other carbohydrates, such as starch and complex sugars, must be broken down by digestion into simple sugars like glucose before the body can use them. Chemists have shown that even a little normally indigestible cellulose in vegetable foods may break down into glucose by bacterial action in the intestine.

Glucose normally makes up 0.1 per cent of the blood. In the disease diabetes, the amount of glucose in the blood increases because the tissues oxidize too small an amount. In this case, excess glucose is given off in the urine. Persons who are ill and unable to take food in a normal way are often given glucose solution directly in the blood stream.

Commercial glucose is a syrup made from cornstarch. The corn is steeped, ground, washed, and heated with hydrochloric acid in closed vessels, called converters. In the converters, the starch changes into glucose, and the acid acts as a chemical catalyst that speeds up the reaction. Later, workers neutralize the acid with sodium carbonate and remove it. The glucose becomes thick and sirupy after the final treatment. Commercial glucose is used in brewing, canning, and candymaking. Glucose is also used in the manufacture of leather filling, soap, and tanning extracts.

GEORGE L. BUSH

See also CARBOHYDRATE; DEXTROSE; SUGAR.

GLUE is a sticky substance made from the skin, bones, and connective tissues of animals. There are three types of true glue: (1) hide or skin glue; (2) bone glue; and (3) fish glue. All are impure forms of gelatin. Other materials are sometimes called glues. But technically they are usually gums, cements, or adhesives.

True glues result from the breaking down of protein matter in animal tissues and bones. When these tissues are heated in water, part of their structure dissolves into a clear solution. After the solution cools it forms a solid, jellylike mass, called *gelatin*. This gelatin is like food gelatin, but it is not pure. Completely dry gelatin is a transparent mass that will dissolve in water to form a solution with great adhesive capacity.

Manufacturers of glue usually obtain the raw materials for their product from slaughterhouses, meat packers, and tanneries. Scraps of hide, ears, tails, tendons, feet, and bones can be used for glue. Fish heads, bones, scales, and skins are also used.

Essentially the same operations are used whether the glue is made from bones, fish, or hides. Manufacturers prepare the basic ingredients, heat the stock, treat it to remove impurities, and dry the solution for use. But they use different methods to prepare the glue.

Preparation. Hides are first washed to remove dirt and then soaked until they are soft. Successive baths in water containing increasing amounts of lime make the hides swell. Washing machines remove most of the lime. Then the hides are ready for cooking.



Joe Clark, *Life*, © 1959 Time, Inc.



Strong Plastic Glue, called epoxy, links its molecules with molecules of the materials it joins. The resulting bond often proves stronger than the materials themselves. To test its adhesive qualities, the glue was applied to a football helmet, above, which was then glued to a crossbar. The glue supported a 195-pound football player dangling from the helmet, right.

SOME USES OF GLUE



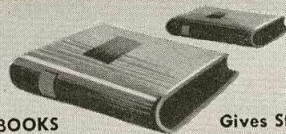
FURNITURE

Used to Join Pieces of Wood Together



LUGGAGE

Binds Various Materials Together Strongly

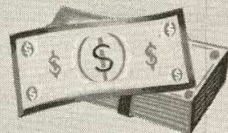


BOOKS

Used in Bookbinding Processes

PAPER MONEY

Gives Strength and Durability to Bills



Bones are washed and the grease is removed before cooking. They may be broken up by an acid gas or a liquid. Or sometimes they are crushed under pressure. Fish parts are washed, and then crushed or shredded.

Cooking Glue. Cooking breaks down the protein matter in tissues and changes it to glue. But care must be taken that the ingredients do not cook too long or at too high a temperature. Either of these conditions destroys the quality of the glue. Cooking is usually done in an open tank. But pressure tanks are widely used for untreated bones. The open tanks consist of large tubs heated by steam coils. The ingredients are placed in the tubs, covered with water, and allowed to cook until the liquid becomes concentrated. Workers drain the extracted liquid and heat it again until the glue becomes thick.

Clearing and Drying. Manufacturers use either chemical or mechanical methods to obtain clear glue. They may add alum, or an acid followed by egg albumin. These form a precipitate that removes the unwanted particles and leaves the glue clear. Some producers use mechanical filters in which the solution filters through paper or bone char. After the filtering process, the glue runs into pans for drying. Machines grind the dry glue and package it for shipping. Persons who use this glue steep it in water until it is soft, then place it in a glue pot containing hot water. Liquid glue is usually

used in homes because it does not need to be heated.

Uses. Manufacturers use glue as a sizing for millinery, textiles, and paper. Furniture makers use it to hold joints together, or to reinforce them. Bookbinders use glue to hold together the bindings and the pages of books. Liquid glue is sometimes used in homes for minor repairs.

C. L. MANTELL

See also ADHESIVE.

GLUTAMIC ACID. See WHEAT (Other Products).

GLUTEN, GLOO tun, is the substance in wheat and other cereal grains that makes dough rise. This grayish-yellow vegetable albumin is tough, sticky, somewhat elastic, and almost tasteless when separated from the grain. Gluten in wheat flour contains chiefly the two proteins, *gliadin* and *glutenin*. It can be separated from the flour if a dough is made from flour and water, and kneaded gently under running cold water. The starch washes away with the water in a milky stream until only the gluten remains.

In breadmaking, gluten holds the carbon dioxide made by the yeast and makes the dough rise (see BREAD). The amount of gluten in flour depends on the kind of wheat used. Gluten usually makes up about 88 per cent of the protein in bread.

LENNA F. COOPER

See also ALBUMIN; PROTEIN; YEAST.

GLUTTON. See WOLVERINE.

GLYCERIDE, or GLYCERID. See FAT.

GLYCERIN

GLYCERIN, *GLIS ur in* (chemical formula, $C_3H_5(OH)_3$), is a sirupy liquid used extensively in the arts and medicine. It is colorless and has little odor, but tastes sweet, and feels oily and warm.

Chemists usually call pure glycerin *glycerol*. Good commercial glycerin contains more than 99 per cent pure glycerol. The chemical formula shows that it is a compound of *carbon*, *hydrogen*, and *oxygen*. At a low temperature, glycerol may solidify into crystals. It rarely does this, however, and chemists do not know just what starts the crystallization. The crystals melt at 63°F. Ordinarily, even the purest glycerin remains liquid, however cold the temperature. The boiling point, 552°F., is extremely high.

It is very hard to set glycerin on fire. Pure glycerin burns with a colorless flame without charring, and leaves no ash. At ordinary temperatures, glycerin does not evaporate. But it absorbs moisture from the air.

Sources. Glycerin is a by-product of the candle and soap industries. The fats and fatty oils found in plants and animals provide the raw materials to make it. These materials include cottonseed oil, lard, and tallow.

In the manufacture of *stearin* for candles, the fats are treated with steam at a high temperature. Usually, the process requires the addition of a small amount of some substance which speeds up the action of the steam on the fat. Lime and sulfuric acid are among these substances, called *catalysts*. The process gives one pound of glycerin for every nine pounds of stearin. Manufacturers boil fats and alkalis together to make soap. One pound of glycerin is produced to about 11 pounds of dry soap. Distillation of the glycerin in superheated steam purifies it.

Uses. Manufacturers add glycerin to many materials to prevent them from drying out. The commodities treated for this purpose include tobacco, copra (dried coconut), candies, heavily starched cotton goods, and inks for rubber stamps.

Glycerin mixes with water and alcohol in all proportions, and dissolves many inorganic and organic substances. Some dyes are dissolved in glycerin, then mixed with water. Stains made on linen by coffee and tea can be removed by moistening the material with glycerin, allowing it to stand for a time, and then steaming or washing it with hot soapy water. Glycerin added to water lowers its freezing point. Mixed with lead oxide, it makes a good cement.

Glycerin feels warm to the touch. This is because it mixes with water which it draws from the skin. Because of its soothing effect, people use glycerin to ease inflammations. The same *emollient* property makes it useful as a cosmetic for chapped hands and sore lips. Locally, it has some antiseptic action.

Taken internally in small doses, it is harmless. Larger doses act as a purgative, and empty the bowels. Glycerin suppositories are small cones to be inserted into the rectum. They absorb water from the surrounding tissues, and cause quick action by this irritation. Glycerin applied to meat and untanned hides preserves them. The greatest industrial use of glycerin is in the manufacture of the powerful explosive *nitroglycerin*. Glycerin also increases a plant's absorption of the antibiotic *Streptomycin*, used for blight control.

See also NITROGLYCERIN; STEARIN.

AUSTIN EDWARD SMITH

GLYCEROL. See GLYCERIN.

GLYCOGEN, *GLYE koh jen*, a tasteless, odorless white powder, belongs to the carbohydrate group of chemicals. It is formed in the liver and muscles from excess starches and sugars taken into the body. Starches and sugars are digested to the simple sugar glucose, which can then be changed into glycogen.

Glycogen, often called "animal starch," is stored in the liver and muscles as a reserve food. It can easily be changed back into glucose. The glycogen of the liver keeps the supply of sugar in the blood at a constant level of 0.1 per cent. Glycogen in the muscles changes into sugar and oxidizes when the body requires quick energy.

GEORGE L. BUSH

See also CARBOHYDRATE; GLUCOSE.

GLYCOL, *GLY kohl*, or *GLY kahl*, is a type of organic compound that has two hydroxyl groups, or $-OH$ groups, attached to separate carbon atoms. Another name for these compounds is *diol*. Glycols are related to alcohols, which have one hydroxyl group attached to a carbon atom.

The simplest glycol is ethylene glycol, which is a rather thick, colorless liquid. Its chemical formula is $CH_2OH \cdot CH_2OH$. It has a high boiling point, and can be mixed with water. For these reasons, this compound has been widely used as a permanent-type antifreeze for automobile cooling systems.

Polymers of ethylene glycol range from water-white liquids to waxlike solids. They are used as lubricants and solvents, and chemical intermediates. Manufacturers use propylene glycol in pharmaceuticals, cosmetics, and even in foods. Propylene glycol is not poisonous.

JAMES S. FRITZ

GNAT, *nat*, is any one of various tiny insects. Many gnats suck blood from animals, but others do not bite. The most common blood-sucker is the mosquito.

All gnats have two wings and a *proboscis* which may be either long and sharp, or short and blunt. The proboscis is a sort of snout, or trunk that the biting type uses to pierce and suck. Most gnats lay their eggs on water, where they float from one to several days and then hatch. Others lay eggs in decaying plant material in mud, in tree holes, or even on dry ground that will later be covered with water. The *buffalo gnat* and its relatives, the *black flies* and *turkey flies*, live in most parts of the world, from the Arctic and Antarctic regions to the tropics.

Many buffalo gnats live in the southern United States.

An almost invisible gnat called the *punkie* is a troublesome pest in the northern woods and parts of the west. Indians called it the "no-see-um." One family of gnats attacks plants and makes galls or swellings on them. The most harmful of these is the Hessian fly.

Scientific Classification. Gnats belong to the family *Simuliidae*. The common gnat is genus *Simulium*, species *vittatum*.

CARL D. DUNCAN

See also DIPTERA; HESSIAN FLY; MOSQUITO.



USDA

The Gnat

The Long-Faced Gnu has big horns and a head like a buffalo. One of the speediest animals in South Africa, it travels with a fast trotting pace, taking large strides.



St. Louis Post-Dispatch, Black Star

GNATCATCHER is any one of several birds native to the Western Hemisphere. Two of them, the blue-gray and the black-tailed, are found in the United States. These birds build small, compact, down-lined nests, which they bind with spider webs and saddle to a limb.

Scientific Classification. Gnatcatchers are in the family *Sylviidae*. The blue-gray is genus *Polioptila*, species *caerulea*. The black-tailed is *P. melanura*. LEONARD W. WING

GNEISS, nice, is a rock made of the same minerals as granite—quartz, feldspar, and mica. These minerals are arranged in layers. Some varieties of gneiss have hornblende, garnet, or other minerals instead of mica.

Gneisses are metamorphic rocks. That is, they are igneous or sedimentary rocks that have crystallized over again. Gneiss is used for paving blocks. Some kinds of gneiss make good building stone. ERNEST E. WAHLSTROM

See also METAMORPHISM; ROCK.

GNOME. See ELF.

GNOMON. See SUNDIAL.

GNOMONIC PROJECTION. See MAP (Azimuthal Projections).

GNOSTIC, NAHS tick, was a member of one of several sects during the early years of Christianity. The Gnostics believed that knowledge, not blind faith, held the key to the mysteries of life. But they thought that knowledge came from spiritual insight, rather than from scientific study. The Gnostics attempted to harmonize Christian beliefs with Greek and Oriental philosophies. They made arbitrary interpretations, and caused much unrest. But they were the first to give the Gospels the same importance as the Epistles of the Apostles. *Gnosticism* refers to the Gnostics' beliefs and activities. ALBERT E. AVEY

GNU, noo, or WILDEBEEST, WILL duh BEEST, is a large, strange-looking African antelope. It has a long tail like a horse and horns like a buffalo. *Gnu* is the Hottentot name, and *wildebeest* the Dutch name.

The gnu has a large head, broad muzzle, and a short, stiff mane. Tufts of long bristly hair grow on the face and the lower side of the head and neck. All gnu have horns and weigh from 300 to 475 pounds.

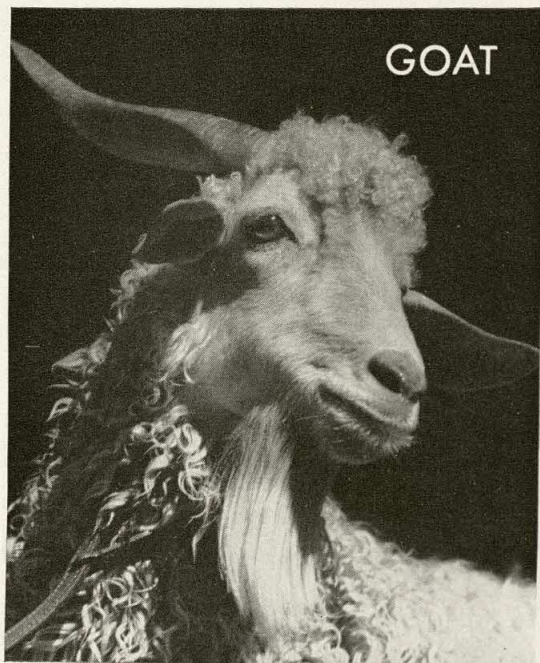
Gnu live in herds on plains or in scattered forests. A cornered gnu is one of the most dangerous fighters of all hoofed animals.

The two species of gnu are the *white-tailed gnu*, with a mane and tail that are white, creamy, or black and white, and the *brindled gnu*. The *brindled gnu* grows larger, and its mane and tail are black. The brindled gnu lives in southern, eastern, and central Africa.

Scientific Classification. Gnu belong to the family *Bovidae*. The white-tailed gnu is genus *Connochaetes*, species *gnu*. The brindled gnu is *C. taurinus*.

See also ANIMAL (color picture, Africa [Brindled Gnu]); ANTELOPE.

GOA, GOH uh (pop. 547,703), is the largest of three districts which make up the Portuguese province of Portuguese India. It lies on the west coast of India, and covers 1,348 square miles. For location, see INDIA (color map). Goa has a coast line of about 65 miles. Rice, spices, and timber are the main products. The city of Nova Goa, or Pangim, is the capital of Portuguese India. In this city is the tomb of Saint Francis Xavier, who died in Goa in 1552. His missionary work made Goa the first Christian colony in the East Indies. See also PORTUGUESE INDIA; XAVIER, SAINT FRANCIS. ROBERT I. CRANE



GOAT

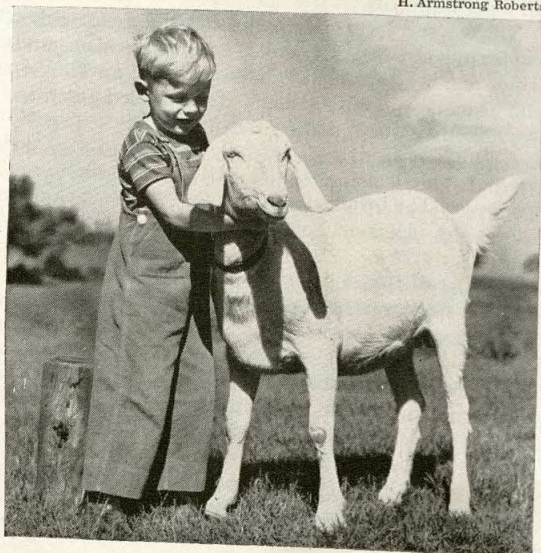
Ylla, Guillumete

GOAT has been called "the poor man's cow." It is a relative of the sheep, useful for its milk, flesh, hair, and hide. Goats can be either wild or domestic.

Like the cow, the goat belongs to the cattle family. It, too, is a grass eater. It has a special stomach so it can hastily swallow its food, store the grass, and then chew it later as a "cud." Most domestic goats weigh from 100 to 120 pounds when grown. They do not grow so large as sheep. Their twisted flat horns turn backward, but not in a spiral like a ram's. Their hoofs are divided in two, or cloven. A goat's tail is shorter than a sheep's and it turns up. The male generally has a beard

The Goat is supposed to be able to live on a diet of tin cans. Goats do not really eat cans, but it is true that they will lick or chew anything that may contain minerals.

H. Armstrong Roberts



◀ **The Milk and Flesh of the Goat** have provided food for people throughout the world since ancient times.

under the chin, and gives off a strong odor. Most females also have beards. Goats are normally covered with straight hair, but some kinds grow wool underneath. They can have many different colors, from black to brown to the pure white Angora.

Goats are rugged animals, and find enough food to eat even on poor dry land. But goats respond to care, and to good food that is not too rich. They do not thrive in a wet climate.

The male goat is sometimes called a *billy goat*, and the female, a *nanny goat*. The proper name for the grown male is *buck*. The female is a *doe*, and a goat less than one year old is a *kid*.

Young goats are carried in the bodies of their mothers for 21 to 23 weeks before they are born. The female usually bears one, two, or three kids at a time. These young goats are born fully haired, with their eyes open. They can run and jump four hours after birth. They are weaned at three to six months. Goats may live 10 to 14 years.

Wild Goats. The 10 species of wild goats live in mountains and rocky places. They are divided into two groups, the *ibexes* and the goats proper. All except the Rocky Mountain wild goat live in Europe and the Himalaya Mountains in Asia. Like the chamois, the Rocky Mountain goat is between the true goats and the antelopes. It lives high in the Rocky Mountains, and is perhaps the best mountain climber among American animals. It has long white hair, and jet-black hoofs, eyes, and horns.

Domestic Goats live throughout the world. They probably are descended from the wild Persian goats of southwestern Asia. People raise large herds in many parts of Europe, Asia, and Africa. Goats in Europe, Egypt, India, China, the United States, Canada, and Mexico are raised mostly to produce milk. Goat's milk is white, sweet, nourishing, and easier to digest than cow's milk. It contains more fat and protein. It has proved helpful for tuberculosis patients, and for persons with stomach and bowel troubles. Probably more people throughout the world use goat's milk than cow's milk. Those who become used to it often like it better than cow's milk. Butter made from goat milk is poor, but it makes some good cheeses.

Goatskins make high-grade leather. The famous morocco leather is made from goatskin. Goats are often trained as pets, and harnessed to children's carts. In many places, they serve as beasts of burden.

Classes of Goats. There are three chief classes of goats. The first are the *Swiss goats*, which have pointed ears. These are the most important ancestors of most American and European breeds. The second type is the *Nubian*, with drooping ears. The third type is the group that grows wool. These goats include the popular *Angora* and the *Cashmere*.

Goats raised for their milk include the Toggenburg, Saanen, and Nubian. The Toggenburg goat was imported to America from Switzerland. In the United States it is the most popular milk goat. There are both long-haired and short-haired Toggenburgs. They have brown hair and a light stripe down each side of the face, and gray or white hair below the knee. A grown doe

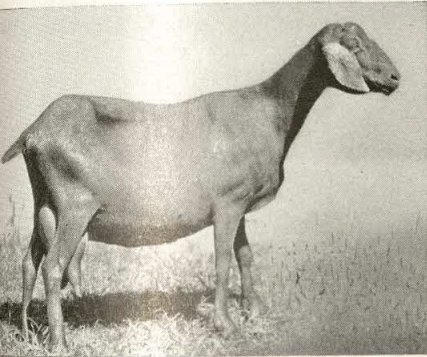


The Angora Goat is raised for its valuable long wool which is used to make clothes and long-lasting mohair rugs.



USDA; New York Zoological Society

The Suleiman Goat has long whiskers and curved horns that are shaped somewhat like a pair of giant corkscrews.



The Nubian Goats are bright brown to black in color. The females give very rich milk.

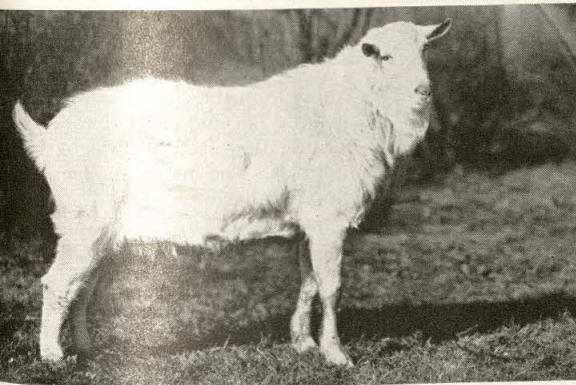


Rocky Mountain Goat is a relative of the true goat.

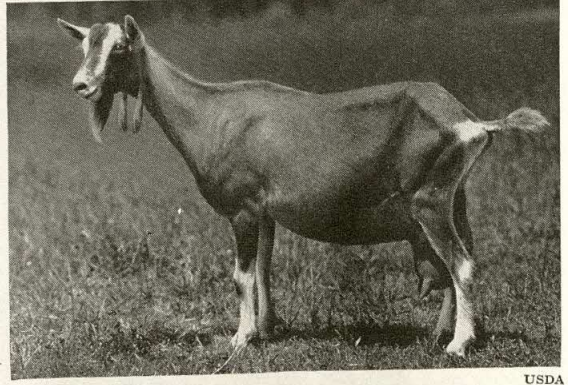


USDA; N.Y. Zoological Society; Holisher

Wild Goats from Asia's Himalaya Mountains make their homes in plains and rocky places.



The Saanen Goat has short hair, and the best are colored white or cream. The female goats give a large amount of milk.



USDA

The Toggenburg Doe weighs between 100 and 135 pounds, and during certain months will give 3 to 6 quarts of milk a day.

SOME MEMBERS OF THE GOAT FAMILY

stands 28 to 38 inches high at the shoulders and weighs about 100 to 135 pounds. She usually gives three to six quarts of milk a day for two to six months a year. The milk is more abundant but of lower quality than that of some other breeds.

The Saanen is another Swiss breed raised in America. These goats have short hair, and the best are pure white or cream-colored. A grown doe weighs 110 to 130 pounds and gives 4 to 6 quarts of milk a day. The production in a year averages 130 to 175 gallons.

The Nubian is a long-eared, Roman-nosed goat that comes from Egypt, Ethiopia, and India. Nubians are

among the largest of goats. An average billy stands 3 feet high. Their short hair is usually black and brown, or black and white. Nubians give rich milk. This breed was crossed with the goats of England to produce the Anglo-Nubian, another good milk goat.

Other breeds of milk goats include the Alpine and the Maltese goats. The Alpine holds the official world record for goat-milk production, 4,551.8 pounds for 10 months. Only a few Maltese, natives of Malta, are raised in the United States. The common, or American, goat is a popular milk goat of the South. It is medium sized and of mixed origin.

GOAT ISLAND

Angoras are the most important breed for the raising and selling of goat hair. They are natives of Asia Minor. Angoras have spiral horns, and a silky white fleece that hangs down in curly locks all over the body. The top hair grows 8 to 10 inches a year. It makes a sleek cloth called *mohair* that is widely used for robes, capes, suits, and plush upholstery. The average goat yields about 2½ pounds of wool at a shearing. An unusual one has given as much as 12 pounds. Most of the mohair grown in the United States comes from Texas and New Mexico. Angoras are also raised along the Pacific Coast. Their flesh has a better flavor than that of any other goat.

The cashmere goats of India also grow valuable hair. They are smaller and more like common white goats than Angoras. Their underhair makes fine cashmere woolen fabrics. This breed is not raised successfully in the United States.

Scientific Classification. Goats belong to the family *Bovidae*. True goats make up the genus *Capra*. The Rocky Mountain goat is classified as genus *Oreamnos*, species *americanus*.

VICTOR H. CAHALANE

Related Articles in WORLD BOOK include:

Animal (color picture,	Mohair
North America [Rocky	Rocky Mountain Goat
Mountain Goat])	Ruminant
Cashmere Goat	Sheep
Ibex	Wool
Leather	

GOAT ISLAND. See NIAGARA FALLS AND NIAGARA RIVER.

GOATSUCKER, or NIGHTJAR, is one of a widespread family of birds that largely fly at night. The nighthawk and whippoorwill belong to this family.

Goatsuckers are 8 to 15 inches long. Their dull

The Goatsucker has soft, owl-like feathers, a wide head, large eyes, and a tiny hooked bill. The name comes from an old belief that goatsuckers lived by sucking milk from goats.



coloring, gray and brown mottled with white, acts as effective camouflage. The wings of goatsuckers are long and slender, and their very short bills have bristles at the base. Goatsuckers catch their chief food, insects, while in flight.

The name goatsucker comes from the old fable that the birds milk goats. This arose because of the birds' wide, soft mouths and because they feed at twilight near grazing, domestic animals. The name *nightjar* comes from their night-flying and jarring cries.

Scientific Classification. The goatsucker family is *Caprimulgidae*. The common goatsucker or nightjar of Europe is *Caprimulgus europaeus*.

HERBERT FRIEDMANN

See also NIGHTHAWK; WHIPPOORWILL.

GOBELIN. See TAPESTRY.

Gobi, GO bee, is a sandswept, treeless desert on a tableland, or plateau, a half mile above sea level in northeastern Asia. It is twice the size of Montana, and covers 500,000 square miles in Inner Mongolia, in China, and in Outer Mongolia. For location, see CHINA (color map).

There are few permanent settlements in the desert, but the construction of irrigation works in the areas of barren earth has slowly attracted some settlers. Most of the few people who live in the Gobi are wandering tribes, or nomads, who move their cattle and sheep from one of the few areas of grassland to another. These tribes go to permanent camps during the long, cold winter.

The explorer Roy Chapman Andrews found indications of a very old civilization in the desert. Other explorers, notably Nikolai Przhevalski and Sven Hedin, have made many valuable findings in the Gobi. The armies of Kublai Khan and Genghis Khan also roamed the





Eastfoto

Shifting Sand in the Gobi Desert of northern China must be held back by protective barriers when railroad tracks are laid.

desert in the Middle Ages. Camel caravans and trucks cross the desert in summer, traveling between China and Siberia. During World War II, this route became important as a means of bringing supplies into China from Russia.

ELDRÉD D. WILSON

See also ANDREWS, ROY CHAPMAN; DESERT; MONGOLIA; NOMAD.

GOBLIN. See FAIRY.

GOD is the Supreme Being, the Creator and Ruler of the Universe, All Knowing, All Powerful, Infinite, and Ever Present. Throughout history, people have believed that there is a Power in the universe greater than themselves. Early peoples were *polytheistic*. They worshiped many gods. Most religions today stress *monotheism*, or the belief in One God. They teach that all the world's powers are expressions of one Supreme Being.

Many devout persons believe in the existence of Almighty God as the most certain of their convictions. Philosophers have given various reasons for their belief that God exists. They see the handiwork of God in all things, even the lowliest plant. They argue that only God could have created an orderly universe. Many speak of God as the *First Cause*. They say that without Him nothing would be or would ever come to be.

Some persons do not believe that there is a God. They are called *atheists*. Others, called *agnostics*, do not deny God, but say that man cannot know whether God exists, or what His nature is. See AGNOSTIC; ATHEIST.

The Old Testament, or Hebrew Bible, does not con-

cern itself with speculation about God's existence. It proclaims it as a fact. It speaks of God as *Adonai*, *Elohim*, and *Yahweh*, and teaches that He must be obeyed, worshiped, and loved as the one true God. The prophets emphasized the ethical relationship between God and man. They taught that God is all good, and demands moral conduct of His people. See JUDAISM.

The New Testament speaks of God as the Father of men, the Savior, and the pure Spirit of Love. He appears as a personal God, at once human and divine. Christians believe that He offers His love and blessings to all through His son Jesus Christ. All Catholic and Eastern Orthodox churches and many Protestant churches accept the doctrine of the *Trinity* as the central teaching of Christianity. They believe that God is one Divine Being in three Persons, Father, Son, and Holy Spirit (or Holy Ghost). Not all Protestants accept this teaching. See TRINITY.

Other Religions. The various religions of the world use different terms in speaking of God. Moslems call Him *Allah*, and insist on the oneness of Allah. They believe that Allah decides all events and all the acts of men. Hindus believe in a single spiritual being called *Brahman*. They hold that Brahman has no traits of either good or evil, and cannot be known by human beings. They pray to other gods who are pale and limited expressions of the supreme Brahman. The Taoists in China seek submission to the *Tao*, the moving force of the universe. In Japan, the Shinto religion does not worship one supreme being. Shintoists pray to hundreds of nature gods and ancestors. See HINDUS; ISLAM; TAOISTS; SHINTOISTS.

Gods of Ancient Times. Scholars have found that many early peoples were polytheistic. Early men peopled their world with spirits and gods representing the natural forces that they did not understand, such as the sun, the wind, and the rain. They thought of their gods as being much like men, with bodies, voices, and human desires. Many ancient peoples later came to regard one of their gods as the most powerful. In Egypt, King Amenhotep IV, or Akhenaton, who reigned from about 1370 to about 1350 B.C., made the god Aton the only one to be worshiped. In Greek mythology, Zeus was king of the gods. The followers of Zoroaster chose their heaven god, Ahura-Mazda, as the supreme one (see ZOROASTRIANS). The ancient Hebrews were monotheists who worshiped Yahweh as their own God. At first they thought of Him as more powerful than the gods of other nations. Later, they taught that He is universal, the God of all mankind. JAMES F. ANDERSON

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Beelzebub	Jehovah	Religion
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GOD BLESS AMERICA is a popular patriotic song of the United States. Irving Berlin composed it in 1917 for his army show *Tip Tip Taphank*, but he did not use or publish it until 1938. The song immediately became popular. See also BERLIN, IRVING.

GOD SAVE THE QUEEN

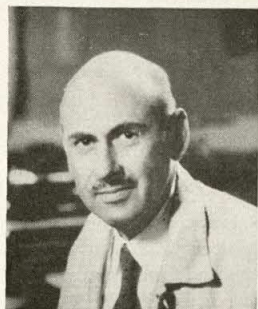
GOD SAVE THE QUEEN, or **GOD SAVE THE KING**, is the national anthem of Great Britain. It is a prayer for the glory and happiness of the King or Queen of England. The United States uses the music for its song "America," and other nations also have adopted the tune. Henry Carey is thought to be the composer of the melody. Since 1933 the melody has been played at a slow tempo in Great Britain, at the request of George V. The words of "God Save the King" are changed when a queen reigns. The first verse follows:

God save our gracious King,
Long live our noble King;
God save the King!
Send him victorious,
Happy and glorious,
Long to reign over us,
God save the King!

RAYMOND KENDALL

GODDARD, JOHN. See FURNITURE (Early American).

GODDARD, ROBERT HUTCHINGS (1882-1945), an American scientist, was the father of modern rocketry and space flight. His experiments with solid and liquid-propellant rockets between 1909 and 1945 helped lead to the development of intercontinental missiles, earth satellites, and the exploration of space. Goddard was the first to prove by test that a rocket works in a vacuum, the first to work out the mathematics of rocket action, and the first to develop rockets equipped with propellant pumps, gyro-controls, and instrumentation. Goddard foresaw many of the space flight ideas that later became reality. In his treatise, "A Method of Reaching Extreme Altitudes"



Wide World

Robert H. Goddard

(1919), he proposed trying to reach the moon by rocket.

Goddard was born in Worcester, Mass., and was educated at Worcester Polytechnic Institute and Clark University. He began working on rockets in his student days. He continued this work as a professor of physics at Clark University. He financed his early work himself. In 1916, the Smithsonian Institution, and later Daniel Guggenheim and The Daniel and Florence Guggenheim Foundation, granted him funds. Ridiculed at first as a "moon man" and dreamer, Goddard lived to see his work win recognition for putting man on the threshold of space.

After his death, Goddard received many honors and awards, including the Congressional Gold Medal and the Langley Gold Medal. The National Aeronautics and Space Administration (NASA) named its research and engineering center at Beltsville, Md., the Goddard Space Flight Center. In 1960, the NASA, army, navy, and air force awarded the Goddard estate and The Daniel and Florence Guggenheim Foundation \$1,000,000 for the use of the Goddard patents.

See also ROCKET (Early Research).

G. EDWARD PENDRAY

GODDEN, RUMER (1909-), is a British author. Her novels, *Black Narcissus* (1939) and *The River* (1946),

were both set in India. They were made into successful motion pictures. Rumer Godden also wrote about England. *A Candle for St. Jude* (1948) concerns a London ballet studio. Some of her other books include *Gypsy*, *Gypsy* (1940), *Take Three Tenses* (1945), and *The Green-gage Summer* (1958). Her books for children include *Doll's House*. She was born in Sussex.

HARRY T. MOORE

GODETIA, *goh DEE shih uh*, is a group of popular annual garden flowers. They belong to the evening primrose family. About 25 kinds grow in North America. A common godetia, sometimes called *farewell-to-spring*, is a slender, branching plant that grows from 12 to 30 inches tall. The leaves are 1 to 2 inches long. The lilac or pink flowers are about 2 inches wide, with satiny petals. The flowers bloom from the middle of July to August. The godetia grows well in the shade. The plant was named after Charles H. Godet, a Swiss botanist.



J. Horace McFarland

The Godetia Flower

Scientific Classification. The common godetia belongs to the family *Onagraceae*. It is genus *Godetia*, species *amoena*.

DONALD WYMAN

See also EVENING PRIMROSE.

Godey's Lady's Book in 1852 carried this picture. Called "The Bower," the picture shows how women dressed in the 1850's. *Godey's Lady's Book* was the first U.S. magazine published for women.



Chicago Public Library

GODEY, LOUIS ANTOINE (1804-1878), in 1830 founded *Godey's Lady's Book*, the first woman's magazine in the United States.

It was edited by Sarah Josepha Hale. Some of the most noted writers of the day wrote for it, including Emerson, Longfellow, Poe, and Hawthorne.

Godey was born in New York City. He had little formal education, but he liked to read. He became self-supporting at the age of 15 when he started work as a clerk on a Philadelphia newspaper.

JOHN TERBEL

GODFREY OF BOUILLON, *boo YAWN* (1060?-1100), a famous early crusader, joined the First Crusade. When the Christians took Jerusalem in 1099, he was elected to rule the conquered city as Protector of the Holy Sepulcher. He defeated the Moslems at Ascalon, completing the conquest of the Holy Land. He set a high standard for his successors.



Historical Pictures

Godfrey of Bouillon, Raymond IV, Boemund of Tarent, and Tancred of Hauteville were the leaders of the First Crusade. The greatest of these was Godfrey, who later ruled Jerusalem.

Godfrey was the second son of Count Eustace of Boulogne, who helped William of Normandy conquer England in 1066. Godfrey's mother was a daughter of Godfrey the Bearded, who at one time was Duke of Lower Lorraine. King Henry IV of Germany made Godfrey Duke of Lower Lorraine in 1087. Bouillon was his capital.

FRANKLIN D. SCOTT

See also **CRUSADES** (The First Crusade).

GODHAVN, *GAHD HAY v'n* (pop. 457), is a seaport in central Greenland. It lies at the southern tip of Disco Island on Davis Strait. For location, see **GREENLAND** (map). Fishing, sealing, and hunting rank as the chief occupations in this region. Godhavn has a magnetic observatory (established in 1926), a biological research station, and a radio station.

JENS NYHOLM

GODIVA, *goh DYE vuh*, **LADY**, the wife of Earl Leofric of Chester, England, lived during the 1000's. She asked her husband to reduce the heavy taxes he imposed as lord of Coventry. He agreed to do so if she would ride naked through the town. She asked all the townspeople to remain indoors, and, clothed only in her long hair, she mounted upon a horse and rode through the streets. According to one story, a tailor named Tom peeped through a shutter and was struck blind. This traditional incident is the origin of our phrase, "Peeping Tom." For centuries, a fair was held at intervals to celebrate Lady Godiva's courage.

KNOX WILSON

GODKIN, EDWARD LAWRENCE (1831-1902), founded *The Nation* and edited it from 1865 to 1901. This liberal weekly newspaper established itself as one of the most influential periodicals in America. In 1881, *The Nation* became the weekly edition of the *New York Evening Post*. Within two years, Godkin was the *Post's* editor. He carried on a successful campaign against the corrupt politicians of New York City's Tammany Hall until he retired. Godkin was born in County Wicklow, Ireland.

JOHN TEBBEL

GODPARENT. See **BAPTISM**.

GODS OF GREECE AND ROME. See **MYTHOLOGY**.

GODTHAAB, *GAWT hawp* (pop. 1,389), is the capital of Greenland. It lies on Davis Strait, near the entrance of Godthaab Fiord. For location, see **GREENLAND** (map). It has a harbor that is ice-free all year. Godthaab is the seat of the Greenland Council. It also has a teachers college and a radio station. Hunting, fishing, and sheep raising are the chief occupations of the region.

A Danish-Norwegian missionary, Hans Egede, set up a mission at this site in 1721. The town was founded in 1728. When World War II cut communications between Greenland and its mother country, Denmark, Greenland was administered from Godthaab. JENS NYHOLM

GODUNOV, BORIS. See **RUSSIA** (The Time of Troubles); **OPERA** (Some of the Famous Operas).

GODWIN, EARL. See **EDWARD THE CONFESSOR**.

GODWIN is the family name of three noted British writers, Mary Wollstonecraft, William, and their daughter, Mary.

Mary Wollstonecraft Godwin (1759-1797), is famous for her book *A Vindication of the Rights of Women* (1792). She argued that if women were not as well-educated as men, marriage could never be a true companionship. Many of her ideas were considered radical. Mary Wollstonecraft was born in Hoxton, England. She went to Paris in 1792 because she was interested in the French Revolution. While there, she fell in love with Captain Gilbert Imlay, an American, by whom she had a child. Later, she married William Godwin. She died after the birth of their daughter.

Lady Godiva rode through the streets of Coventry, England, clothed only in her long hair, according to an old English legend. Sir Edwin Landseer painted this *Sidesaddle Godiva* in 1866.

Brown Bros.



GODWIN-AUSTEN, MOUNT

William Godwin (1756-1836), was influenced by his reading of French philosophers of the 1700's, and became a freethinker and social reformer. His *Political Justice* (1793) greatly influenced the English liberal movement. The poet, Percy Bysshe Shelley, was one of many young men who came under his spell. Godwin believed that men could wipe out evil. He thought all government should be abolished through education. Godwin was born at Wisbeach.

Mary Godwin (1797-1851), the daughter of Mary Wollstonecraft and William, married the poet Shelley. She wrote *Frankenstein* (see FRANKENSTEIN). SCOTT ELLEDGE

GODWIN-AUSTEN, MOUNT. See MOUNT GODWIN-AUSTEN.

GODWIT, *GAHD* wit, is a wading bird of the snipe and sandpiper family. The godwit has a long bill which is curved slightly upward. It has long wings and a short tail. The body is 16 to 21 inches long. The godwits include the Hudsonian, the Pacific, and the marbled.

Scientific Classification. Godwits belong to the family *Sclopacidae*. The Hudsonian godwit is genus *Limosa*, species *haemastica*; the marbled, *L. fedoa*; and the Pacific, *L. lapponica*, subspecies *baueri*.

ALFRED M. BAILEY

See also SANDPIPER; SNIPE.

GOEBBELS, *GUB* uls, **PAUL JOSEPH** (1897-1945), was the official propagandist of Nazi Germany. As Minister of Popular Enlightenment and Propaganda, he tried to persuade both the Germans and the outside world to believe what the Nazis desired. He controlled publications, radio programs, motion pictures, and the arts in Germany, and in German-dominated Europe.

Goebbels was born in Rheydt, the son of peasants. He helped Hitler bring the Nazis to power in 1933, and then worked at persuading the Germans to support the Hitler regime. A fanatical Nazi, he and his family committed suicide when Germany fell at the end of World War II.

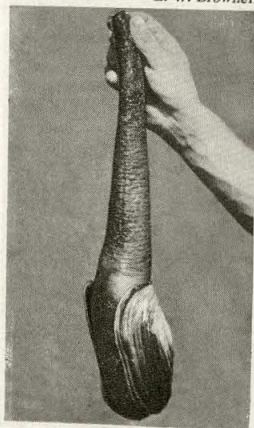
LESTER B. MASON

See also NAZISM; WORLD WAR II (Psychological Warfare).

GOEDUCK, *GWEE* duk, or **GWEDUC**, is a west American clam that is larger than any other except the giant clam of the East Indies. The goeduck lives along the Pacific Coast from Puget Sound to San Diego. Its shell grows about 6 inches long, and the clam itself may weigh as much as 6 pounds.

The Goeduck Clam

L. W. Brownell



Its name, also spelled *goeduck*, comes from an Indian word meaning to dig deep. The goeduck burrows from 2 to 3 feet into muddy sand. Its long siphons reach above to the surface. Its mantle has two lobes, and its shell is made of two equal parts, called valves. The goeduck feeds on tiny living things in the sea.

Scientific Classification. The goeduck is in the family *Saxicavidae*. It is classified as genus *Panope*, species *generosa*.

WILLIAM J. CLENCH

See also CLAM.

GOERING, *GUH* ring, **HERMANN WILHELM** (1893-1946), was second to Adolf Hitler as a leader of Nazi Germany. He became Reich Marshal, and commanded the German air force. He also headed the German armament and war industry. He was the only Nazi with a distinguished service record in World War I.

Goering was born at Rosenheim, and became one of Hitler's followers in the early 1920's. Elected to the Reichstag (German legislature) in 1928, he became its president. This enabled him to frustrate democratic procedures, and help Hitler gain unlimited power in 1933. At the start of World War II, he was chosen as Hitler's successor. But his influence declined when the air force was unable to subdue England, prevent the invasion of the European continent, or stop the bombing of Germany.

Goering loved extravagant entertainment and delighted in lavish uniforms and unusual military decorations. But even though he had a jovial personality, he was ruthless with opponents and rivals. Goering was judged guilty of war crimes at Nuremberg for approving concentration camps and the hated secret police. He took poison just before he was scheduled to be hanged. LESTER B. MASON

GOES, HUGO VANDER.

See VAN DER GOES, HUGO.

GOETHALS, *GO* thulz, **GEORGE WASHINGTON**

(1858-1928), an American civil engineer and army officer, directed the completion of the Panama Canal. In 1907, after two civilian engineers had resigned from the job, President Theodore Roosevelt appointed Goethals as chief of the army engineers supervising construction of the canal.

Goethals overcame many problems of organization, supply, sanitation, and health; and the canal was ready for use ahead of schedule. In 1914, Goethals retired from the army to serve as the first civilian governor of the Panama Canal Zone. He resigned in 1916. See PANAMA CANAL.

Early Life. Goethals was born in Brooklyn, N.Y. He attended the College of the City of New York, and was graduated in 1880 from the U.S. Military Academy. He served as a second lieutenant with the corps of engineers until 1885, and then taught civil and military engineering at West Point until 1887. Then Goethals supervised the construction of the canal, locks, and dams of the Muscle Shoals project on the Tennessee River, which was completed in 1889.

During the Spanish-American War in 1898, Goethals served as a lieutenant colonel and as chief of engineers in the First Army Corps. He was assigned to the General

Hermann Goering
United Press Int.



Brown Bros.

George Goethals

Staff of the United States Army from 1903 to 1907. **Engineer and Supply Officer.** After his work on the Panama Canal, Goethals helped administer the Adamson Eight-Hour law, which established the eight-hour day for railroad workers engaged in interstate commerce. He also worked as a highway engineer for the state of New Jersey. In 1917 Goethals was recalled to active duty as general manager of the U.S. Shipping Board Emergency Fleet Corporation. He also served as acting Quartermaster General of the Army and as assistant chief of staff and director of the Army's Division of Purchase, Storage, and Traffic. He was one of the greatest supply men produced during the war.

Goethals retired from the army in 1919 and established a firm of consulting engineers. His company acted as consultant in developing the inner harbor of New Orleans, and on the Columbia Basin irrigation project. Goethals served as chief consulting engineer for the Port of New York Authority. He received many honors and was frequently called upon by state and national governments as an adviser. ROBERT E. SCHOFIELD

GOETHE, GAY tuh, JOHANN WOLFGANG VON (1749-1832), Germany's most famous writer, was one of the world's greatest literary geniuses. His extraordinary imagination and versatility is unmatched in Western literature. He was highly successful in almost every field of writing. Although his political and scientific work is dwarfed by his artistic production, it shows his breadth of vision and the adaptability of his talent.

Background of Culture. Goethe was born at Frankfurt-am-Main on Aug. 28, 1749. His father was a wealthy judge with an outstanding reputation. His mother was the daughter of the ruling *burgomaster*, or mayor, of Frankfurt, and was 21 years younger than her husband. Goethe's father hired private tutors, and personally supervised his son's early education in languages, history, science, and painting.

At 16, Goethe was sent to the University of Leipzig to study law. But he became more interested in the theater, literature, and the fine arts. The irregular student life ruined his health, and he was forced to return to Frankfurt. It took him more than a year to recover from his illness.

In the spring of 1770, Goethe's father sent him to the University of Strasbourg to continue his study of law. He received his degree in 1771. While he was in Strasbourg, he met Johann Gottfried Herder, who introduced him to new literary ideas and to such authors as Homer, William Shakespeare, and Jean Jacques Rousseau. Herder gave Goethe a new understanding of folklore and the poetry of the Bible.

Goethe's charming and profound love affair with Frederike Brion, daughter of the minister at Sesenheim, was another important experience during this period. The affair helped Goethe mature both personally and as an artist.

First Successes. In the fall of 1771, Goethe began practicing law in Frankfurt, with his father's help and guidance. But his work did not satisfy him. During a brief stay at the Imperial Court of Justice in Wetzlar, he fell in love with the fiancée of a colleague and friend. He returned to Frankfurt in order to avoid a scandal, and remained there until 1775. During that time, he wrote the first of the works that made him famous. They include the tragic drama, *Gotz von Berlichingen* (1773),



Historical Pictures Service

Young Goethe, left, sent the manuscript for *Gotz von Berlichingen* to the publishers in the early 1770's, above. He wrote this drama in six weeks.



Brown Bros.

and the novel, *The Sorrows of Young Werther* (1774).

At Weimar. At the invitation of Karl August, the 18-year-old Duke of Saxe-Weimar, Goethe went in 1775 to live in Weimar, the capital of the little dukedom and a city of about 6,000 inhabitants. He held a succession of government posts and became the duke's chief adviser. He proved to be a tireless, capable, and conscientious minister of state. But, in 1786, he grew tired of his life in the provincial town, and left for a long trip to Italy. When he returned in 1788, he retired from his state offices but kept the direction of the ducal theater at Weimar.

In 1794, Goethe began his stimulating friendship with the poet Johann Friedrich von Schiller, which lasted until Schiller's death in 1805. After 1794, Goethe devoted himself chiefly to literature and his extensive studies of the natural sciences. His enormous science collections are still admired by visitors from all parts of the world. Goethe died at Weimar on March 22, 1832. His last words were "Mehr licht!" (More light!)

Contribution to World Literature. Goethe's novel *The Sorrows of Young Werther* was the first great German contribution to world literature. It made him world famous at 25. Napoleon Bonaparte read this moving story of unfulfilled love seven times. He was so impressed by it that he wanted to meet Goethe. Goethe's two

GOG AND MAGOG

other novels, *The Apprenticeship of Wilhelm Meister* (1795-1796), an educational novel, and *Elective Affinities* (1809), a marriage story, became models for later German novelists. He also wrote a four-volume autobiography, *Poetry and Truth* (1811-1833).

Goethe's fame as a dramatist outside of Germany rests mainly upon *Faust*, a tragedy on which he worked for 60 years. This account of man's tragic journey through life to hell and heaven, with the devil as companion and God as the final goal, is the greatest German literary creation.

Goethe wrote other plays which are still performed in German theaters. They include *Götz von Berlichingen*, *Iphigenie auf Tauris* (1787), *Egmont* (1788), and *Torquato Tasso* (1790).

Goethe remains unsurpassed as a poet, the creator of some of the most beautiful poems in any language. The poems, written over the whole range of his life, move and delight readers. They include the early love songs written in Strasbourg, the poems of classical perfection during the time of his friendship with Schiller, the lyrical wonders of his *West-Ostlicher Divan* (1819), and the immortal verses of the *Marienbader Elegie*, last fruits of his wise old age.

G. F. MERKEL

See also FAUST; GERMAN LITERATURE; MEPHISTOPHELES.

GOG AND MAGOG appear in the New Testament as two nations that make war on the Kingdom of Christ after being deceived by Satan (Rev. 20: 8). But in the Old Testament (Ezekiel 38-39), Gog is a prince of the land of Magog who leads the barbarian hordes of the north in an assault on Israel. Some scholars think Gog was Gyges, a king of Lydia in the 600's B.C.

In Genesis 10: 2, Magog is son of Japheth, and a member of one of the peoples that lived north of Israel. Two famous statues at the Guildhall in London are called Gog and Magog. They were erected during the 1400's, and were replaced in 1708 and again after World War II.

JOHN BRIGHT

GOGH, VINCENT VAN. See VAN GOGH, VINCENT.

GOGOL, GAW gawl, NIKOLAI VASILIEVICH (1809-1852), was a major Russian novelist and dramatist. His tales are noteworthy for their grotesque, romantic, and humorous caricatures, and for their bright, exaggerated, and fresh style. His comedy, *The Inspector-General* (1836), a moral satire against bad government officials, often is regarded as the greatest Russian play. Its laughable characters and amusing situations have kept it popular. He produced his great novel, *Dead Souls*, and a famous short story, "The Overcoat," in 1842.

Gogol was born in the Ukraine. He had an advanced high school education there, and at 19 went to Saint Petersburg (now Leningrad). He failed in his efforts to achieve fame as an actor, and was a civil service clerk and a history teacher. His first collection of stories, *Evenings on a Farm near Dikanka* (1831), brought him attention from readers, and also from the poet Alexander Pushkin, who encouraged the young writer's literary hopes.

From 1836 to 1844, Gogol lived abroad, mostly in Rome. He returned to Russia for short stays. During this period he wrote his novel *Dead Souls*.

In his later years, Gogol's great imaginative powers failed him. He grew mentally ill, and believed he had a divine mission to reform his sinful countrymen. He sought relief in religious pilgrimages and ascetic practices. In a fit of depression, he burned the manuscript to the second part of *Dead Souls* and claimed it was a practical joke played on him by the devil. After this catastrophe, he fell into a state of melancholy, then became ill and died.

ERNEST J. SIMMONS

GOIDELIC. See CELT; GAEL.

GOITER, GOI tur, is a condition in which the thyroid gland becomes enlarged because it is either overactive or not active enough. This gland lies toward the front of the neck between the Adam's apple and the top of the breastbone.

The thyroid gland is one of the most important of the ductless, or *endocrine*, glands. Its secretions control the rate of growth in children, and the rate of chemical changes in bodies of both adults and children. A person with a high rate of chemical change, or *metabolism*, is mentally alert, energetic, and physically active. One with a low metabolic rate is dull and sluggish. The thyroid gland also affects respiration, pulse rate, brain functions, and other ductless glands.

Doctors have identified several kinds of goiter. *Anatomical* goiter is an enlargement that often occurs in rapidly growing older children. It frequently disappears soon after growth stops. *Toxic* goiter accompanies overactivity of the thyroid gland. A person with toxic goiter suffers nervousness, rapid and irritable heart, shallow breathing, extreme hunger, and loss of weight. When the eyeballs protrude in toxic goiter, the condition is sometimes called *exophthalmic* goiter. In the *hidden*, or *inward*, goiter condition, the enlarged mass lies behind the breastbone, and cannot be seen in the neck.

Myxedema goiter results from an underactive thyroid gland. When myxedema develops in adults, it causes slowness of mind and body, thickness of speech, low metabolism, and thickening of the skin. *Cretinism* is the name of this condition in children. *Dwarfism* and *idiocy* are the chief characteristics of cretinism. Myxedema most frequently results from lack of iodine in food and drinking water. It may also result from rapid growth, pregnancy, or great emotional strain. Doctors treat it by giving patients an iodine preparation called *thyroxine*, an extract from thyroid glands.

Goiter occurs most commonly in the Great Lakes region and in some areas around the Rocky Mountains in the United States, and in certain mountainous districts of Switzerland. Drinking water in these places is low in iodine. Goiter rarely occurs along coastal regions where the water is rich in ocean iodine.

Goiter can be prevented by including sea food in the diet, eating table salt and drinking water that contains iodine, or taking iodine in some other form. But the amount of iodine taken into the body must be small. Living healthfully, especially during late childhood and pregnancy, also helps prevent goiter.

Doctors often treat goiter by surgery, especially in the toxic or choking forms. X-ray treatments have also proved effective. Doctors also use the drug *thiouracil* for treatment of toxic goiter.

HYMAN S. RUBINSTEIN

See also CRETINISM; IODINE; MAYO (Charles H.); METABOLISM; THYROID GLAND.

GOLAN. See CITIES OF REFUGE.

GOLD (chemical symbol, Au). This metallic element was one of the first known of all metals. The early cave man knew of gold. Possession of this bright yellow metal has been a mark of wealth for thousands of years. The ancient Egyptians knew how to hammer gold into leaves so thin that it took 367,000 leaves to make a pile an inch high. During the Middle Ages, a whole science called *alchemy* grew up around man's efforts to make gold by artificial means.

Modern scientists have succeeded in making some of the alchemists' dreams come true. They can now extract gold from sea water, and the atom smasher can make gold from lead. The atom smasher can also make an unstable form of gold from platinum and iridium, both of which are more valuable than gold. But all the gold produced commercially still comes from the earth.

The mining of gold has become an important industry which is carefully supervised by the governments of all gold-producing countries.

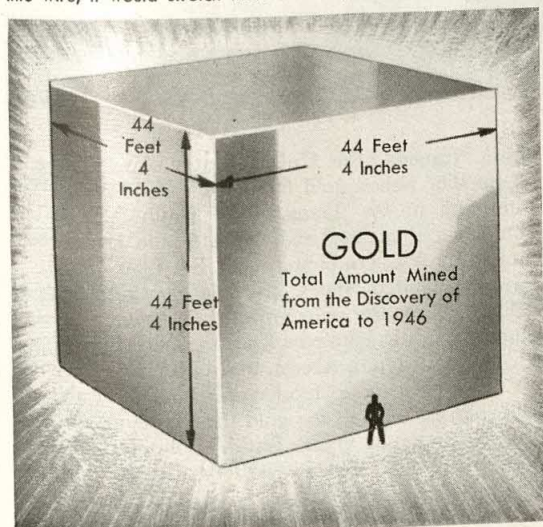
Properties of Gold

Gold has been valuable throughout the ages chiefly because it is scarce. But this metal owes much to its physical properties of beauty, softness, resistance to chemicals, and density. Gold has a lovely yellow color and a soft metallic glow. Its softness makes it easy to work with. Scientists describe gold as *ductile* because it can be drawn out into fine wire. They say it is *malleable* because it can be hammered into thin sheets. It can be shaped into any form that is desired. After it is shaped, its resistance to rust and other chemical changes from the air keeps it from tarnishing.

When gold is to be made into a hard object, such as a piece of jewelry, it must be combined with some other metal. Such a substance is called an *alloy*. Gold alloys are measured by *carats*. A carat is equal to one twenty-fourth part. Thus, 24 carat (24K) gold is pure gold. Eighteen carat gold is 18 parts pure gold to 6 parts of alloy.

Pure gold melts at 1,945° F. It is in Group I of the

Gold Mined from 1492 to 1946 would form a cube weighing 1,194,913,916 ounces. One pound of gold makes a thin wire 900 miles long. If all the gold in the cube were pounded into wire, it would stretch more than 67,000,000,000 miles.



Federal Reserve Bank of New York

A Wall of Gold lines a vault in the Federal Reserve Bank of New York. Each gold brick weighs 27 pounds. A stack of seven bricks weighs more than an average man.

table of chemical elements, with an atomic weight of 197 and an atomic number of 79. Gold can be dissolved in a mixture of hydrochloric and nitric acids, called *aqua regia* (see AQUA REGIA). It may also be dissolved in alkaline cyanide solutions, a hot solution of ferric chloride, thiosulfate solutions, mercury, or nascent (free) chlorine.

How Gold Is Formed

Scientists believe that gold is deposited from gases and liquids rising from beneath the earth's surface. These gases and liquids travel toward the surface through cracks, or *faults*, in the crust. Gold is found in lode, or vein, deposits, in placer deposits, as a minor element in porphyry copper, and in sea water.

Lode, or Vein, Deposits are veins in the earth's crust.

Placer Deposits are large particles, called *nuggets*, and grains of gold in the beds of streams. These particles have been washed and carried away from a lode, or vein, by surface water, usually floodwater. Sometimes, such nuggets have been very large. The "Welcome Nugget," found in Australia, weighed 248 pounds. Placer deposits are of two types, cluvial and alluvial. *Eluvial* deposits are found close to the vein of gold. *Alluvial* deposits are farther away, usually in stream beds.

Some gold is found in the bulky copper deposits called porphyry copper deposits.

Gold in Sea Water. All sea water contains gold in

METHODS OF GOLD MINING



Panning



HYDRAULIC GIANT

Water Pressure washes gold-bearing gravel down a riffled trough which traps the gold.

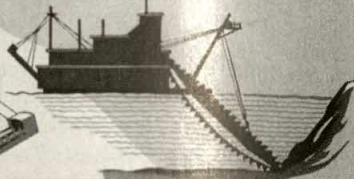


Cradle Sifting

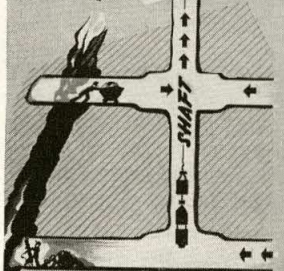
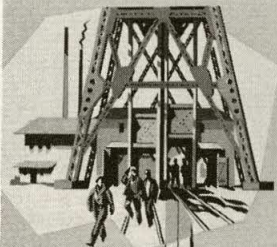
Early Methods of PLACERMINING



DREDGE



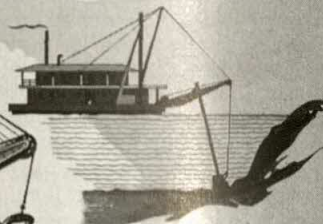
Chain of Buckets scoop placer gold from the stream bed and dump it into the barge.



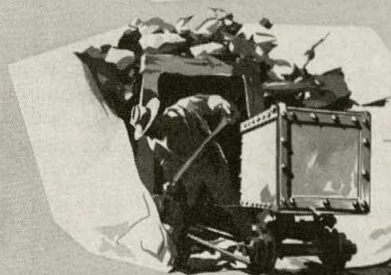
Vertical Shaft goes into the earth and branches out to meet the gold veins.



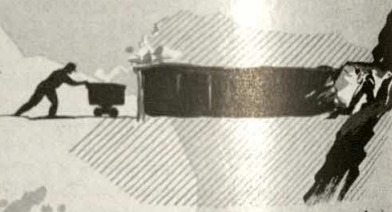
POWER SHOVEL



Floating Steam Shovel scoops up dirt and gravel and dumps it into a near-by gold separator.



HORIZONTAL SHAFT



Open-Cut Mining is done from the surface when the vein reaches to the top.

solution. The average amount is about one grain (five cents' worth) of gold to one ton of water. For this reason, it is not feasible to mine gold from sea water, though it may be in the future.

Gold is seldom found in an unalloyed, or pure, state. It is usually combined with silver in a natural alloy called an *electrum*. But it is usually associated with quartz, calcite, lead, tellurium, zinc, or copper, and is usually mined as a by-product of these metals. Only about 40 per cent of the gold production of this country is obtained from what may rightly be called gold mines.

World Gold Fields

The chief gold-producing countries of the world, in order of importance, are the Union of South Africa,

Russia, Canada, the United States, Australia, and Ghana. The richest gold field of the world is the Witwatersrand in the Transvaal of South Africa. The Homestead mine at Lead, S.D., is the largest gold mine in the Western Hemisphere. See LEAD [S.D.].

In the United States, the Mother Lode fields of California for many years supplied the greatest amount of gold. South Dakota now leads the states in gold production, with Utah, Alaska, and California following.

Ontario, Canada, is another of North America's great gold sources. Most of the gold there is found in large, deep, quartz-gold veins. British Columbia and the placer deposits of Yukon Territory also are important gold-producing areas.

Western Australia has been famous for lode gold for

many years. During the early 1900's, the Philippines also became important producers of gold.

How Gold Is Mined

The methods for obtaining gold vary according to the type of deposit. Two steps are necessary in all types of deposits: (1) to obtain the gold ore, and (2) to separate the gold from the ore.

In most placer mining, both these operations take place at the scene of the gold deposits. But in underground mining, the ore is usually mined, transported to mills, and separated and concentrated there.

All methods of placer mining are primarily a *sifting* (gravity separation) process. In the early days of placer mining, men *panned* the gold by hand. Sometimes they swirled water and gravel from an ordinary frying pan, leaving the heavier gold in the pan. But usually the hand miner used a shovel to scoop the gravel into a sort of cradle which held about six cubic feet of material. He rocked this cradle, washing and sifting out all the lighter materials until only the gold was left.

The Hydraulic Giant is a means whereby water is directed at high pressure onto banks of gold-bearing gravel. The water washes the gravel banks into troughs, or *sluices*, which contain devices called *riffles* to trap the gold as the earth and gravel wash through.

The Dredge is a power-driven gold-mining machine. It consists of a chain of buckets on a barge. Each bucket holds about six cubic feet of material. The buckets are lowered into the water on a boom. They revolve in a continuous chain to bring up placer gold from the stream bed. The dredge, which is usually on a barge that floats in a stream, also carries equipment to separate the gold from the other material.

Many countries will not allow either dredging or hydraulic mining because they destroy land and streams.

Dragline dredges, often simply called *drag lines*, are lines of weighted dredge buckets which are dragged along the bottom of streams to gather up dirt and gravel containing placer deposits of gold.

Power Shovels are huge machines which scoop up large quantities of gold-bearing sand and gravel from

stream beds. These shovels also work in connection with other equipment to separate the gold from other materials on the spot.

Lode, or vein, deposits of gold are mined in much the same way as coal or other minerals. Shafts which follow the direction of the vein are dug into the ground. Some gold is mined from the surface of the ground, where it may be contained in *open cuts*. The ore is broken up by exploding charges of dynamite placed in long holes bored into the rock by air-driven drills.

The Milling Process

There are three different milling methods generally used in separating gold from its ores or from sea water. These methods are called *flotation*, *amalgamation*, and *cyanidation*.

Flotation. In the flotation process, particles of the finely ground ore are separated from each other according to the abilities of the different metals in the ore to attach themselves to an oily froth. Oils and chemicals, called *flotation reagents*, are mixed into the water before the ground ore is mixed in. Three types of chemicals are used, a frothing agent, a collecting agent, and a variety of inorganic chemicals. The *frothing agent* causes the water to foam. The *collecting agent* forms a film on the gold so that it will stick to air bubbles which go to the top. The *inorganic chemicals* keep other metals from filming along with the gold. After the ore is placed in the water, air is blown in. This is called *aeration*. The gold particles are carried to the top in air bubbles and are skimmed off this frothy layer.

Amalgamation is a method for collecting gold from other materials by using mercury. It is based on the tendency of gold to form an alloy, or *amalgam*, with mercury. The ore is finely ground and mixed with water to form a pulp. The wet pulp is passed through traps which separate the different minerals in the ore according to their weights. Finally, the pulp is passed over copper plates coated with mercury. These plates attract and capture most of the remaining free gold. The gold

GOLD

SIX LEADING GOLD STATES

South Dakota	559,337 oz.	      
Utah	385,875 oz.	     
Alaska	215,123 oz.	   
California	200,456 oz.	  
Arizona	142,289 oz.	 
Colorado	88,428 oz.	

Each symbol  stands for 50,000 fine ounces of gold mined each year.

Based on a 4-year average of government statistics.

SIX LEADING GOLD COUNTRIES

Union of South Africa	16,299,097 oz.	      
Russia (est.)	9,750,000 oz.	     
Canada	4,474,182 oz.	   
United States	1,825,258 oz.	 
Australia	1,065,429 oz.	
Ghana	742,030 oz.	

Each symbol  stands for 800,000 fine ounces of gold mined each year.

Based on a 4-year average of government statistics.

DIFFERENT USES OF GOLD



JEWELRY

Gold Alloyed with other Metals



RUBY GLASS

Made with Chemically Treated Gold



STANDARD OF VALUE

Gold Vault at Fort Knox, Ky.



PRINTING

Gold Lettering and Gilding



PHOTOGRAPHY

Gold Chloride for Toning



DENTISTRY

Tooth Fillings and Braces



ADVERTISING SIGNS

Made from Attractive Gold Leaf



GOLD LACE

Gold Threads Wound through Silk

is then freed from the amalgam by heating it until the mercury boils off.

Cyanidation is a process in which the ground ore is placed in a tank containing a weak solution of cyanide. The gold in the solution is then separated, or precipitated, by contact with metallic zinc. The resulting material is melted, or *smelted*, and cast into bars of gold bullion.

Uses of Gold

Standard of Value. The chief use of gold is as a standard of value for money. During the early part of the 1900's, most of the countries of the world were on the *gold standard*. This meant that a stated amount of gold could be obtained for most paper money at any national bank or at the national treasury. In the United States during this period, each paper dollar had a value of 25.8 grains of gold in the national treasury.

In 1933, the gold value of the dollar was lowered considerably, and the United States officially "went off the gold standard." That is, paper money could no longer be redeemed in gold. Nevertheless, gold was still the standard of measurement for the dollar, which now is defined as being worth 13.714 grains of pure gold. Gold coins have not been minted in the United States since 1933. Since 1937, most of this nation's gold bullion has been stored in an underground depository at Fort Knox, Ky.

Countries sometimes are forced to use their gold

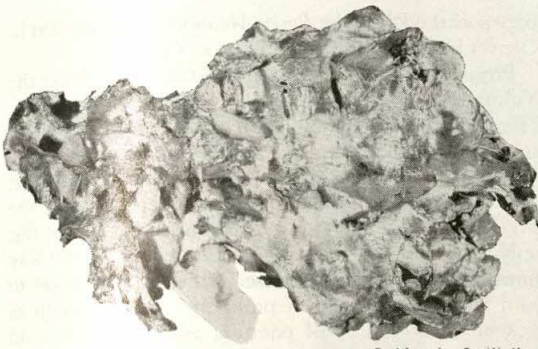
reserves to make payments when their currency is unacceptable to those from whom they buy.

Jewelry. Gold is alloyed with other metals such as copper and silver to make many kinds of jewelry. *White gold*, made from silver and gold, is a common setting for precious stones in rings. See JEWELRY.

Other Uses. Gold is alloyed with copper or silver to make *gold leaf*. The metal is melted, molded into a bar, and then passed between rollers until it becomes a flattened ribbon about one eight-hundredth of an inch thick. The ribbon is cut into pieces one inch square, then laid between leaves of a very thin, tough paper. When there are 210 sheets of gold in the pile, it is called a *cutch*. This is bound in parchment, and laid on a marble block. Then it is beaten with a large hammer which may weigh as much as seventeen pounds.

After the first beating, the gold sheets have become three and one-half inches square. Each of these is cut into four squares and placed between leaves of a special membrane made from the intestines of an ox. This membrane is called *goldbeater's skin*. Now it is beaten with a ten-pound hammer for twenty minutes.

The sheets are again taken out and again cut in four pieces each, then beaten by a seven-pound hammer. This reduces them, after about four hours, to sheets so thin that light shines through them. They are about one two-hundred-thousandth of an inch thick. The thin leaves are picked up by wooden pincers, laid on a leather cushion, and trimmed with a knife made of rattan to



Smithsonian Institution

Some of the Gold Mined in California is found in large, leaflike aggregates which also contain small pieces of quartz.

Gold Found in Quartz Veins in the earth's crust usually occurs as threads, scales, or grains among the crystals of quartz.



sheets three and one-half inches square. Twenty-five of these, between sheets of paper, make a "book." The books are sold in packs of twenty. Gold leaf is used in the arts for lettering and gilding. Dentists also use it in large quantities to make fillings in teeth. Two other forms of gold, called gold pellets and sponge gold, are also used in dentistry. A type of precipitated gold is used in manufacturing ruby glass. It is called *purple of Cassius*. *Gold lace* is made by twining very fine strips of gold around silk.

History of Gold

It is not known when gold was first discovered. But vessels made as early as 3500 B.C. have been dug up at Ur in Mesopotamia (now Iraq). The skilled craftsmanship shown in these gold objects suggests that the craft of working gold had been developed hundreds of years before they were made. The softness of gold made it easily worked by these people.

History tells many stories of the efforts of the alchemists to make gold during the Middle Ages. During the 1500's, the Spanish conquerors sought gold in the lands

of the Aztecs in Mexico and of the Incas in Peru. These were the days when famous pirates and roving privateers looted the galleons which were carrying Spanish plunder from the Americas to Spain. In those days, a legend grew up about a land rich in gold called *El Dorado*, meaning *the golden*. Here, gold was supposed to be as common as sand. Through the centuries, many men set out to find El Dorado, and they often thought they had found it. The rich gold discoveries in California, in Australasia, in Alaska, and in South Africa were all believed to be El Dorado at first. Each discovery began a gold rush, of which the great gold rush to California in 1849 is probably most famous. Men and women came to California from all over the world. In 1828, Georgia had the first gold rush in America.

From the discovery of America to the mid-1950's, the world has produced more than 2,330,000,000 ounces of gold. This is enough gold to make a cube measuring more than 44 feet on each side. HARRISON ASHLEY SCHMITT

Related Articles in WORLD BOOK include:

Alchemy	Ductility	Goldsmithing	South Dakota
Alloy	El Dorado	Gravity, Specific	(color picture, Largest Gold Mine)
Amalgam	Forty-Niner	Jewelry	
Australia	Gilding	Malleability	
Bullion	Gold Leaf	Mining	
Carat	Gold Rush	Money	

Outline

- I. Properties of Gold
- II. How Gold Is Formed
 - A. Lode, or Vein, Deposits
 - B. Placer Deposits
 - C. Gold in Sea Water
- III. World Gold Fields
- IV. How Gold Is Mined
 - A. The Hydraulic Giant
 - B. The Dredge
 - C. Power Shovels
- V. The Milling Process
 - A. Flotation
 - B. Amalgamation
 - C. Cyanidation
- VI. Uses of Gold
 - A. Standard of Value
 - B. Jewelry
 - C. Other Uses
- VII. History of Gold

Questions

- Why do governments keep possession of much of the gold of the world?
- What qualities make gold a desirable metal?
- How are gold alloys measured?
- How is gold taken from placer mines?
- What are the chief gold-producing countries?
- Why do some countries forbid placer mining?
- What is meant by "milling" gold?
- What was El Dorado?

GOLD CERTIFICATE. See MONEY (United States Paper Money).

GOLD COAST. See GHANA.

GOLD CURE. See KEELEY, LESLIE.

GOLD LEAF is gold beaten into thin strips used for gilding and other purposes. It is also used to letter signs on glass. Painters apply gold leaf to a window by means of a pasty material called *size*. The size is put in the area to be lettered, and tiny bits of gold leaf are applied with an instrument called a *gilder's tip*. Gold leaf is usually put on the inside of a window. In *surface gilding*, it is applied to the outside of a glass surface. See also GILDING; GOLD (Other Uses).

GOLD RUSH

GOLD RUSH. The whispered word "gold" has acted on men like a fever since they first learned to cherish this glittering metal. Discovery of new gold fields once drew thousands of prospectors in a gold rush. In the 1800's, men traveled by boat, on foot, or on horseback to reach gold fields where they hoped to make their fortunes. Towns grew up overnight, and new territories were explored and developed. Men and women underwent great hardships as they struggled to reach and stake out their claims ahead of other prospectors.

On January 24, 1848, James Wilson Marshall discovered gold at Sutter's Mill in California. As the news spread, men flocked to the vicinity to establish gold claims. By 1849, a large-scale gold rush was under way. San Francisco grew from a small town to a city of 25,000 in a year's time. Prices paid for food and lodging soared sky-high, because gold was cheap and commodities were scarce. Shacks rented for \$100 and more a week, and a night's rest on a simple cot cost as much as \$15. So many miners went to California that the territory had enough people to be admitted as a state in 1850.

A gold rush to Colorado in 1858 was marked by the slogan "Pikes Peak or Bust." One of the first news-

papers of the West, the *Rocky Mountain News*, started in Denver in 1859 during the height of the rush.

Prospectors found gold in the Klondike district of the Yukon in 1897, and a gold rush began. In July, 1897, Skagway was little more than a dock and a general store. Three weeks later it was a town of almost 4,000. Eggs sold for a dollar apiece, and a plate of ham and eggs cost \$10. More than 10,000 prospectors started the overland route from Skagway to Dawson in a year, but only 2,000 finished the trip. Many died along the way from cold, hunger, or disease. Others were forced to turn back. But some men probably made as much as \$5,000 in three days of panning gold. Sacks of gold served as money. Men guessed at their value by lifting them.

Gold rushes have been responsible for the development of mines and communities in many parts of the world, including Australia, South Africa, West Africa, Malaya, Mexico, and Siberia.

JOHN R. ALDEN

Related Subjects. See also the following articles:

Alaska (Gold-Rush Days)	Colorado (Gold-Rush Days)	Klondike Western
Australia (The Gold Rushes)	Fargo, William George	Frontier Life (The Search for Gold and Silver)
California (The Gold Rush)	Forty-Niner Gold	

The Discovery of Gold in California, Colorado, and the Yukon in the 1800's drew thousands of prospectors to these regions and began the settlement of many communities.

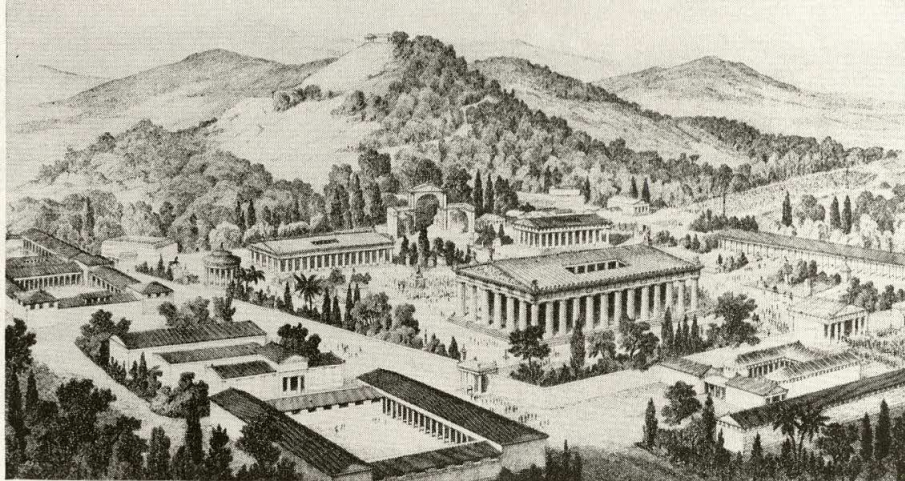
Historical Pictures Service

Prospectors During the 1849 Gold Rush in California searched in streams for gold, below. Water washed the gold down from veins in the mountains.

Ayer Collection, Newberry Library



The Golden Age in Greece centered in and about the Agora, or market place. Its shops, theaters, and government buildings stood at the foot of the Acropolis, the fortified hill in Athens.



Historical Pictures Service

GOLD STANDARD. A country is *on the gold standard* when it will redeem any of its money in gold and when it agrees to buy and sell gold at a fixed price. This ties the country's currency to that of other countries also following the gold standard. The United States used the gold standard from 1900 to 1933. In 1934, it dropped the gold standard by recalling all gold coins, giving Federal Reserve banks certificates for this gold, and backing Federal Reserve notes with certificates of gold deposit.

LEONARD C. R. LANGER

See also MONEY (Gold Standard).

GOLD STANDARD ACT. See MONEY (Changes in the Monetary System).

GOLD STAR. See DECORATIONS AND MEDALS.

GOLD STAR MOTHERS, AMERICAN, is an organization of women who lost their sons in World Wars I and II. It received its name from the custom of placing a gold star on a service flag in honor of a man killed in war. The organization has about 25,000 members. It was founded in 1928 and has national headquarters in Washington, D.C.

HARRIETT T. MASINGUFP

GOLD STAR MOTHER'S DAY honors mothers who lost their sons in World War I and II and the Korean War. The American Gold Star Mothers, Inc., had requested Congress to authorize such a day. In 1936, Congress passed a resolution authorizing the President "to issue a proclamation calling upon the government officials to display the United States flag on all government buildings, and the people of the United States to display the flag and to hold appropriate meetings . . . as a public expression of the love, sorrow, and reverence of the people of the United States for the American Gold Star Mothers." Each President since 1940 has issued a proclamation each year officially designating the last Sunday in September for the observance of Gold Star Mother's Day.

RAYMOND HOYT JAHN

GOLD STAR WIVES OF AMERICA, INC., is an organization of widows of servicemen who died in service or from service-connected disabilities after discharge. Members meet for mutual understanding and helpfulness. Chapters have junior groups of the children of such servicemen. These members meet each year, with their mothers, at a national convention. The organization was founded in New York in 1945.

GOLDBERG, "RUBE," REUBEN L. See CARTOON (Leading Cartoonists).

GOLDBERGER, JOSEPH (1874-1929), an American

physician, is remembered chiefly for his work on pellagra. He proved the disease was caused by lack of milk and meat, the main sources of vitamin B. After studying pellagra in asylums and institutions, he produced it in inmates by limiting their diets (see PELLAGRA). He also added to the knowledge of yellow fever, typhoid, typhus, Rocky Mountain spotted fever, straw-mite itch, measles, diphtheria, and influenza. He was born in Giralt, Hungary.

HENRY H. FERTIG

GOLDEN AGE is a term used by the Greek poet Homer to describe a remote period of the past that he considered more civilized and enlightened than his own. Homer had no written records that described such a period. But he might have been acquainted with the traditions of the wonderful Mycenaean and Cretan civilizations that had flourished long before the time in which he lived.

Many historians have applied the phrase *Golden Age* to the period when a nation reaches its highest peak of development, particularly in art, architecture, literature, or science. For example, most historians maintain that the Golden Age of Greece actually dawned in the age of Pericles, from 461 to 431 B.C., long after Homer's time. During that period, Athens reached great heights in sculpture, architecture, and drama. Many other nations also enjoyed eras that have been described as their Golden Age. Historians would probably agree on the following Golden Ages:

Egypt, 2200-2050 B.C., literature; Herakleopolitan Period, 2150-2050 B.C.; wealth and empire, 1570 to about 1100 B.C. (18th and early 19th dynasties).

Rome, 27 B.C.-A.D. 14, the Age of Augustus.

Mexico, 1440-1520, the reign of the Montezumas.

Spain, 1474-1516, the reign of Ferdinand and Isabella.

England, 1558-1603, the reign of Elizabeth I.

France, 1640-1740, the reigns of Louis XIV and Louis XV.

People of many nations regard the legendary past of their ancestors as their Golden Age of glory. They usually have few facts about these periods, but use their imaginations to fill the times with the highest virtues and ideals. They often speak of "the good old days" as having been the best.

KEITH C. SEELE

See also AEGEAN CIVILIZATION; AGE; HOMER.

GOLDEN BELL. See FORSYTHIA.

GOLDEN BULL. See CHARLES (IV) of the Holy Roman Empire.

GOLDEN CALF

GOLDEN CALF was an image made by Aaron for the people of Israel to worship (Exod. 32:1-8). Moses, their leader, was up on Mount Sinai at the time the calf was made. When he returned with the Ten Commandments, he found his people engaged in a festival in honor of this god. In his rage he destroyed the image.

Bull worship was common in the ancient world. Other mention is made of it in connection with the golden calves of Jeroboam (I Kings 12:26-33). The people of Egypt worshiped the living Apis bull. In Canaan, bulls were associated with the cult of Baal. **CYRUS H. GORDON**

See also **ANIMAL WORSHIP**.

GOLDEN CHAIN. See **LABURNUM**.

GOLDEN FLEECE, in Greek mythology, was the golden wool of the sacred ram Chrysomallus. The fleece hung from a tree in a forest near the Black Sea, and a fierce dragon who never slept guarded it.

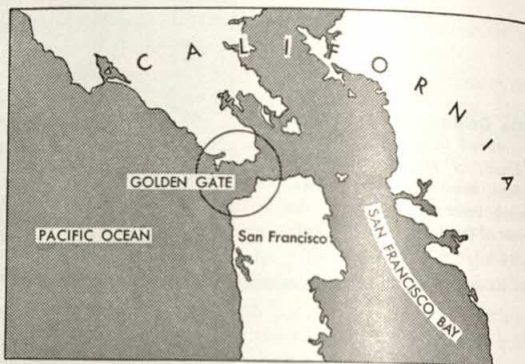
King Pelias sent his nephew Jason to bring the fleece to him. He told Jason that finding the fleece would prove him worthy to inherit the throne. Jason gathered a crew of young men for his expedition. They called themselves the Argonauts. They sailed in the ship Argo to Colchis, the land of the golden fleece.

The king of Colchis told Jason he could have the fleece if he would sow the teeth of a dragon and fight the crop of men that resulted. With the help of Medea, the king's daughter, Jason did as he was asked and went to get the fleece. Medea put the dragon who guarded it to sleep, and returned with Jason to present the fleece to King Pelias.

See also **ARGONAUTS**; **JASON**; **MEDEA**.

Jason and the Golden Fleece is a story from Greek mythology. To obtain the fleece, Jason was forced to harness the fierce bulls and kill the dragon that guarded the tree.

CULVER



The Golden Gate Is the Entrance to San Francisco Bay.

GOLDEN GATE is a steep-sided channel at the entrance to San Francisco Bay. The Golden Gate Bridge spans the harbor opening. The channel measures four miles long and about one mile wide. It is deep enough for the largest ships. For location, see **CALIFORNIA** (color map). The English explorer Francis Drake saw the Golden Gate in 1578, and may have given it its name. However, the American explorer J. C. Frémont claims that he named the Golden Gate. The Forty-Niners en route to the gold fields regarded the name as a good-luck symbol (see **FORTY-NINER**).

GEORGE SHAFFEL

GOLDEN GATE BRIDGE is one of the largest and most spectacular suspension bridges in the world. It spans the Pacific Ocean for a distance of 6,450 feet to connect northern California to the peninsula of San Francisco. The huge towers of the bridge are among the first structures seen from ships as they approach San Francisco. These towers stand on either side of the bridge, about 1,125 feet from the ends. They hold up the two steel cables, 36½ inches in diameter, from which the bridge hangs. The center section of the bridge between the towers is 4,200 feet long, the longest single span in the world. The floor of the bridge is 220 feet above the water, and 90 feet wide. It has a concrete six-lane road and sidewalks. Joseph B. Strauss designed the bridge. Engineers completed it in May, 1937, at a cost of \$35,500,000.

ALEXANDER LAING

See also **CALIFORNIA** (color picture).

GOLDEN GATE COLLEGE is a coeducational school in San Francisco, Calif. It offers courses in accountancy, advertising, insurance, law, management, real estate, traffic, and general studies. The college has the first evening law school (founded in 1901), the first school of traffic (founded in 1903), and the first school of insurance (founded in 1927) on the Pacific Coast. The YMCA founded the school in 1901. It was incorporated as a college in 1923. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

ALMA T. RODGERS

GOLDEN GATE INTERNATIONAL EXPOSITION was held in San Francisco in 1939 and 1940. It was called *A Pageant of the Pacific*. The exposition showed the achievements of countries that border the Pacific Ocean. It stressed the progress made possible through peaceful cooperation. The exposition was held on Treasure Island, in San Francisco Bay.

GOLDEN GLOVES TOURNAMENT. See **BOXING** (Amateur Boxing).

GOLDEN HORN. See **ISTANBUL**.

GOLDEN MEAN. See **ARISTOTLE**.

GOLDEN RETRIEVER is a medium-sized hunting dog. It has won recognition in Great Britain and the United States as a smart, hard-working gun dog. The golden retriever stands from 20 to 24 inches high at the shoulder, and weighs from 55 to 70 pounds. It has a thick, double coat of flat, taffy-colored hair, and may have a few white hairs on its chest. Although trained as retrievers, some of these dogs may learn to hunt live game. They were first bred in Scotland about 1870. See also Dog (color picture, Sporting Dogs).

WILLIAM F. BROWN

GOLDEN ROBIN. See BALTIMORE ORIOLE.

GOLDEN RULE is a precept, or rule of life, set forth by Jesus Christ in the Sermon on the Mount. According to Matthew 7: 12, He preached, "Therefore all things whatsoever ye would that men should do to you, do ye even so to them." (See also Luke 6: 31.) This rule may have been part of an early Christian catechism. People today believe that it should guide us in our treatment of our neighbors.

The same principle is found in other great religions, although sometimes in a negative form. Hillel, the famous Jewish rabbi, said, "What is hateful to thee, do not unto thy fellowman." In different versions, the rule has appeared in the teachings and writings of such philosophers as Confucius and Plato. An old saying of the ancient world was: "Do not do to others what you do not want done to you." Jesus Christ's rule differed from these ancient precepts because His has a positive and universally benevolent character. In negative form, the rule becomes merely a principle of limitation and of restraint.

BERNARD RAMM and FULTON J. SHEEN

GOLDEN SPIKE NATIONAL HISTORIC SITE. See UTAH (National Parks).

GOLDEN STATE. See CALIFORNIA.

GOLDEN TREASURY. See ANTHOLOGY.

GOLDEN TRIANGLE. See PITTSBURGH (Government and History).

GOLDEN-WINGED WOODPECKER. See FLICKER.

GOLDENEYE. See DUCK (Wild Ducks).

GOLDENROD, a common wild flower, belongs to the composite family. About 100 kinds grow in North America, and a few grow in Europe. The goldenrod grows along dry roadsides, in moist woods, in swamps and peat bogs, and in cultivated gardens. The most common kinds include the *early goldenrod*, the large, handsome *Canada goldenrod*, the *blue-stemmed*, the *showy*, and the *sweet goldenrod*, or *Blue Mountain tea*.

The goldenrod has a slender stem like a wand. The leaves and stem may be smooth or hairy. The leaves may also have toothed, or jagged, edges. The bright yellow, or deep golden, flowers grow in thick, graceful clusters at the top of the stem. The flowers bloom in the late summer or early autumn. People incorrectly believe that the pollen of goldenrod causes hay fever and similar allergies. Its pollen is too moist and sticky to float freely through the air. The pollen of ragweed and several other light weeds, easily carried by the wind, is the real cause.

The goldenrod is a favorite flower in America, and the suggestion has been made to adopt it as the national flower of the United States. Kentucky and Nebraska have adopted the goldenrod as their state emblem. Farmers find many of the goldenrods valuable as forage. People often dry the early goldenrod for interior decoration. Some brew the leaves of the sweet goldenrod

to make tea. These leaves also produce an oil, used in medicine as a tonic. Thomas A. Edison developed a method for extracting natural rubber from the goldenrod, but the process proved too expensive for commercial use.

Scientific Classification. Goldenrod belongs to the family *Compositae*. The early goldenrod is genus *Solidago*, species *juncea*; the Canada goldenrod, *S. canadensis*; the blue-stemmed, *S. caesia*. The showy goldenrod is *S. speciosa*; and the sweet, *S. odora*.

LOUIS PYENSON

See also FLOWER (color picture, Flowers of Roadside, Field, and Prairie).

GOLDENSEAL, or **ORANGEROOT**, is a perennial flowering plant of the eastern United States. It is sometimes called *yellow puccoon*, *yellowroot*, or *Indian turmeric*. It gets its name from its thick yellow root. Commercial growers dry and grind the roots for medicinal use. The plant's showy, lobed leaves may be 8 inches wide. Its greenish-white flowers are $\frac{1}{4}$ inch across. The golden-seal bears red fruits in large clusters.

Scientific Classification. Goldenseals belong to the buttercup family, *Ranunculaceae*. They are genus *Hydrastis*, species *canadensis*.

DONALD WYMAN

GOLDFIELD, Nev. (pop. 300), was the scene of one of the greatest gold rushes of all times. The town lies on a high plateau about 26 miles south of Tonopah. It is the county seat of Esmeralda County. For location, see NEVADA (color map). The gold rush began when rich gold deposits were discovered in 1903. By 1906, the town had a population of 20,000. The Goldfield mines produced \$11,000,000 a year in gold by 1910. But the operations soon exhausted the mines. In 1948, some mining activity was resumed in the area.

LUCIUS BEEBE

GOLDFINCH is an attractive songbird often called the *wild canary* because of its lovely song. The *American goldfinch*, the most common species in America, is found over most of the United States and southern Canada. This goldfinch has been adopted as the state bird of Iowa, Minnesota, New Jersey, and Washington.

The American goldfinch is about $4\frac{1}{2}$ inches long. The male has a bright yellow body with a black head, wings, and tail. The female is olive brown above and yellowish below. These birds build compact nests shaped like cups. They weave plant fibers and thistledown so tightly that the nests will hold water. Goldfinches nest from July through September. The female lays from three to six pale blue or bluish-white eggs.

Goldfinches like company, and often gather in small groups on the branches of a tree to bask in the sun. Their song is soft, and similar to that of a canary.

The *European goldfinch* lives throughout Europe, where people used it as a cage bird for many centuries. In the late 1800's, the bird was introduced into the United States, but it became established only on Long Island and in adjacent areas of New York. The European goldfinch has a red face. Its coat is gaudily marked with cinnamon brown above and white below.

Scientific Classification. Goldfinches belong to the finch family, *Fringillidae*. The American goldfinch is genus *Spinus*, species *tristis*. The European goldfinch is *Carduelis carduelis*.

GEORGE J. WALLACE

See also BIRD (table, State Birds; How to Identify Birds; color pictures, Birds That Help Us; Birds' Eggs); FINCH.

GOLDFISH

GOLDFISH is a type of carp also called *golden carp*. Young goldfish do not have bright colors, but many develop brilliant hues. They are all called goldfish, though their colors range from red, gold, and orange to bronze, brown, gray, black, and white. Multi-colored goldfish are produced by selective breeding from plain-colored goldfish. Goldfish are widely used in many lands as an ornamental fish.

Kinds of Goldfish. Although 100 fancy varieties exist, only about 20 kinds of goldfish are sold today. They have such names as *comet*, *nymph*, *fantail*, and *veiltail*, which tell how they differ from each other. Some have scales so thin that they can hardly be seen. They are called *scalesless*. These have deep red colors, and may have spots of blue, purple, lavender, or calico. Some grow only 2 or 3 inches long, and others grow to more than a foot in length.

Some goldfish live to be very old. Golden carp are known to have lived over 50 years. Wild goldfish usually do not live longer than 15 years, and most goldfish in homes live less than five years.

Their Care. Goldfish require little care compared with

many pets. A container with straight sides is better than a curved bowl, because it gives more surface for the absorption of air. The water should be about 65°F. Extreme changes of temperature are harmful. The water must be clean. Goldfish should be fed once a day. They like to eat worms, bread crumbs, water fleas, and plants. They need something in the tank to provide shade because they have no eyelids. See **AQUARIUM** (A Home Aquarium).

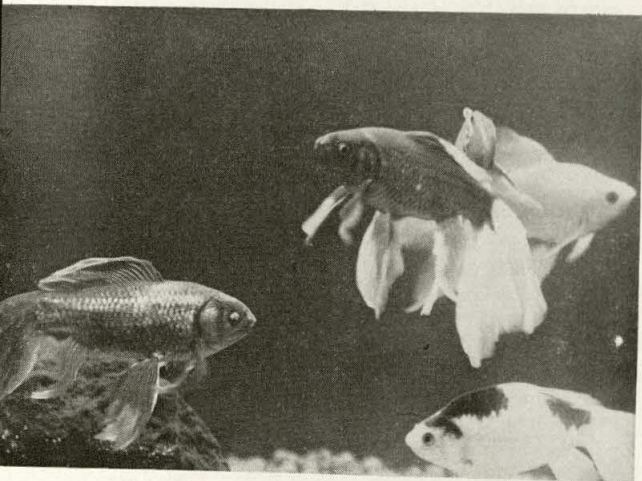
Their Beginnings. The ancestor of the goldfish is a plain-colored fish of China and Japan. Goldfish placed in bodies of flowing water, such as lakes and rivers, soon lose their striking appearance and look like their plain-colored ancestors. Centuries ago, the Chinese bred goldfish to produce beautiful colorings and unusual fins and body forms. The Japanese helped create many of the strange kinds seen today.

Goldfish were first bred in the United States in 1878. Today there are goldfish farms in many parts of the United States.

Scientific Classification. Goldfish belong to the family *Cyprinidae*. They are classified as genus *Carassus*, species *auratus*.

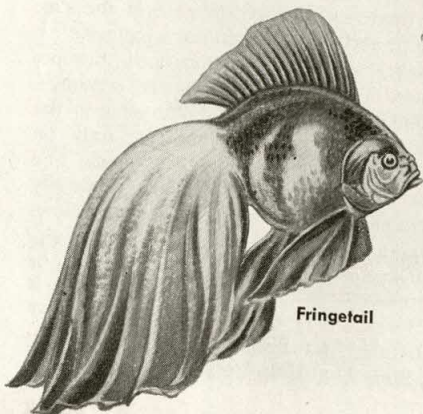
CARL L. HUBBS

See also **CARP**.

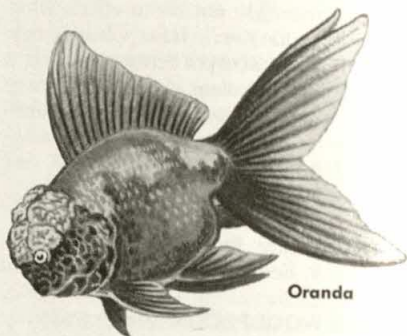


Comet Goldfish

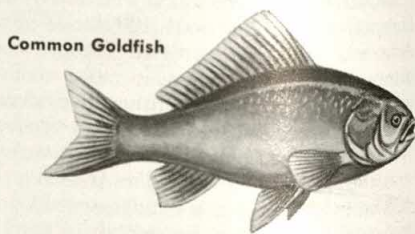
Black Moor



Fringetail



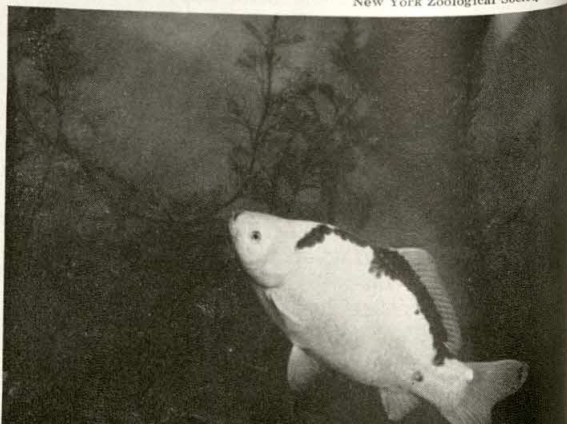
Oranda



Common Goldfish

Common Goldfish

New York Zoological Society



GOLDMAN, EDWIN FRANKO (1878-1956), founded the famous Goldman Band which gave public concerts in New York City for many years. He composed many marches and wrote several books on band music.

Goldman was born in Louisville, Ky., of a family of musicians. At 17, he joined the Metropolitan Opera Orchestra as cornetist. Later he became a noted cornet teacher. Goldman conducted an orchestra for the first time in 1908, and organized his own band in 1918. At first, he presented only concerts of band music. Later, he became an important musical educator when he introduced symphonic music in his public concerts. Goldman founded the American Bandmaster's Association in 1929.

IRVING KOLODIN

GOLDSMITH, OLIVER (1728-1774), an English writer, is best known for three works. His poem "The Deserted Village" (1770) describes the joys of life in a country town and criticizes the economic, social, and moral forces responsible for the decline of the village. *The Vicar of Wakefield* (1766) is a short novel about the family of a country clergyman. His play *She Stoops to Conquer* (1773) is a comedy about a young London gentleman who falls in love with the daughter of a country squire when he mistakes her for the barmaid at an inn. Young and old readers still enjoy these works.



Chicago Historical Society
Oliver Goldsmith

Goldsmith was born in Ireland, the son of a poor Protestant clergyman. He received his bachelor's degree from Trinity College in Dublin, and became a tutor for a wealthy family. He planned to emigrate to America, but changed his mind and decided to study law at Dublin. But he again changed his mind. He studied medicine for a short time at the universities of Edinburgh and Leiden, in The Netherlands, but never took a degree. For more than a year, he wandered over Europe living on what he could earn by playing his flute and telling stories. When he returned to England, he got a job as a book reviewer. From that time on, he supported himself by writing.

Goldsmith was a man who always lived beyond his means. Though one of the most graceful of English writers, he was awkward in conversation. Nevertheless, his friends included some of the greatest Englishmen of his time, such as Samuel Johnson, Sir Joshua Reynolds, Edmund Burke, and David Garrick. Goldsmith died at 46 of a nervous disorder, aggravated by worry over gambling debts.

SCOTT ELLEDGE

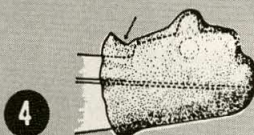
See also NEWBERRY, JOHN; NURSERY RHYME.

GOLDSMITHING is the art of making jewelry and other objects from gold. It ranks as one of the oldest arts and has been practiced for thousands of years. Goldsmiths have made some of the world's most beautiful art objects.

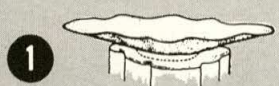
Probably the oldest examples of the goldsmith's art have been found in ancient Egyptian tombs. The Egyptians were skilled at shaping gold and soldering it into jewelry. The Greeks and Romans also were skilled goldsmiths. The Greeks made gold objects decorated



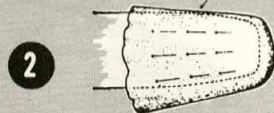
Latin-American Goldsmiths hammered and stretched gold to make decorative objects such as this effigy beaker thousands of years ago.



Put carved wood form in vessel to shape face and a wedge behind it to narrow neck.



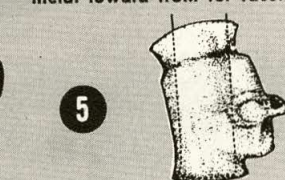
1 To begin vessel, sink the center of a thin sheet of gold in a hollow in the end of a log.



2 Place the metal over a piece of wood and stretch toward the mouth by hammering.



3 Continued hammering pushes metal toward front for face.



5 Flatten the beaker base by hammering it on a flat anvil.

with embossed patterns or with tiny dots of gold.

In England, the art of goldsmithing goes back at least to 1180, when the first known goldsmiths' guild was established. In 1327, the Guild of London Goldsmiths received a royal charter. The English goldsmiths acted as money lenders and bankers in addition to making jewelry and other gold and silver objects. Goldsmithing probably reached its greatest development during the Renaissance in Italy. Benvenuto Cellini of Florence was probably the greatest Italian goldsmith. Cellini's work became so well known for its beauty that he was called to Rome to make gold objects for Pope Clement VII (see CELLINI, BENVENUTO).

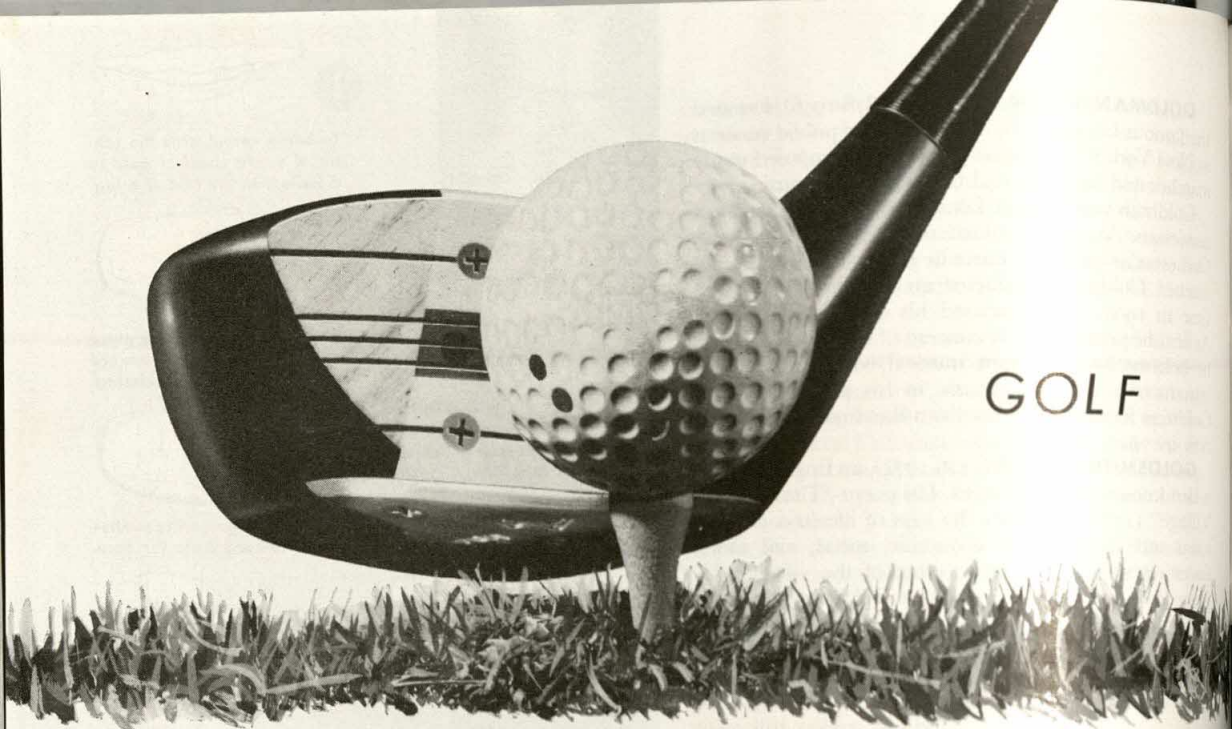
Today, goldsmithing is part of the jeweler's art. But the methods of making gold objects has changed little.

GOLDTIT. See VERDIN.

GOLDWATER, BARRY MORRIS (1909-), became a leader of the conservative wing of the Republican party in the 1960's. He won prominence when his name was placed in nomination as a presidential candidate at the 1960 Republican national convention. His book, *Conscience of a Conservative* (1960), calls for a return to "limited government." Goldwater was elected to the United States Senate from Arizona in 1953, and was re-elected in 1959. He served in the U.S. Army Air Forces in World War II. He was born in Phoenix.

GOLDWYN, SAMUEL (1882-), pioneered in American motion-picture production. He became noted for discovering writing and acting talent, for the taste and artistry of his films, and for his free and vivid use of language. "Include me out," is a famous "Goldwynism." His films include *The Best Years of Our Lives* (1947), *The Secret Life of Walter Mitty* (1947), *Guys and Dolls* (1955), and *Porgy and Bess* (1959). Born in Warsaw, Poland, Goldwyn came to the United States when he was 13.

BARNARD HEWITT



GOLF

The MacGregor Co.

GOLF. More people play golf than any other outdoor sport. Every year, millions of golfers walk or ride over golf courses, swinging at a small white ball with long, slender clubs. Golf emphasizes skill rather than strength. Each player tries to make as low a score as possible, but he must not interfere with his opponent's play. In these ways, golf differs from such sports as football and basketball. Persons of all ages—men and women, boys and girls—enjoy golf. The game offers exercise, healthful surroundings, and the challenge of overcoming such obstacles as water holes, sand traps, and trees and bushes.

About 5,500,000 persons play golf in the United States every year. About a fourth of them are women. American golfers play on more than 4,000 private courses, 1,500 daily-fee courses (privately-owned courses that admit the public for a fee), and over 900 publicly owned courses. These 6,400 courses occupy land valued at about \$1,250,000,000. Americans spend about \$25,000,000 a year on golf balls, and more than \$100,000,000 for clubs and other golfing equipment.

Golf is also a popular spectator sport. Thousands of golf fans follow famous golfers around the courses each year as they compete for trophies and cash prizes in tournaments.

How to Play Golf

The golfer tries to hit his ball into a distant hole in the fewest strokes possible. He uses one of several kinds of clubs to hit the ball. He competes against *par*, the number of strokes that the course officials decide are normally necessary to hit the ball into the hole. Par may vary from three to six strokes, depending on the length and difficulty of the hole. An expert golfer averages four strokes for each hole, or a score of 72 for 18 holes. This allows an average of two strokes to reach the green, and two putts to "sink" the ball in the hole.

The Course, or playing area, consists of either 9 or 18 holes. A person plays a *round* of golf when he plays 18 holes in their correct order. If the course has only

9 holes, golfers usually play over it twice for a round.

Play starts on a small, flat area called the *teeing ground*. Each player puts his ball on a plastic or wooden *tee* or peg. He cannot touch the ball again until he *holes out*, or hits it into the hole. After driving the ball from the teeing ground, each player hits his ball with various clubs to another small, closely mowed area called the *putting green*. There he *putts* the ball, usually in one or two short, gentle strokes, into the hole, which is $\frac{4\frac{1}{2}}$ inches in diameter. Then the golfers move on to the next teeing ground.

The entire area from the teeing ground to the hole is usually called *the hole*. It has no standard shape or length. It may be from 100 to 600 yards long, and the ground may be level or rolling, straight or curved.

Each golfer tries to keep his ball on the *fairway*, a stretch of mowed grass between the teeing ground and the putting green. If he hits the ball inaccurately, he may hit it into *the rough*, an area that usually borders the fairway on each side. The rough has higher grass than the fairway, and may also have bushes and trees. It is more difficult to hit the ball from the rough.

The edges of the fairways and the approaches to the putting greens often have *bunkers*, or *sand traps*. These obstacles may be mounds, or they may be low places in

GOLF TERMS

Address. A golfer is said to "address" the ball when he takes his stance to hit the ball, and rests the club head on the ground just behind the ball.

Birdie occurs when a golfer scores one stroke under par on a hole.

Bogey, *BOH gih*, occurs when a player scores one stroke more than par on a hole.

Divot, *DIHV ut*, is a piece of turf knocked out of the ground when the club hits the ground below the ball.

Eagle occurs when a golfer scores two strokes under par on any but par-3 holes.

Handicap, an allowance of a certain number of strokes, is given to a golfer competing against more skilled players. He deducts his handicap from his total score.

the ground filled with sand. Hitting the ball from bunkers is especially difficult, and golfers try to avoid these traps. Many courses also have creeks, ditches, ponds, or rivers, and some border an ocean or a lake. If a golfer's ball goes into one of these *water hazards*, he may lift it out or play with another ball. But he must add an extra stroke to his score as a penalty.

About half the holes of an 18-hole course are usually of medium length, or from 300 to 450 yards. The other half are generally divided between short holes (100 to 250 yards) and long holes (451 yards or more). On rare occasions, a golfer scores a *hole-in-one* by knocking the ball from the teeing ground into the hole in one stroke.

Eighteen-hole courses cover from about 90 to 150 acres. Nine-hole courses cover about half this area. The holes are arranged so that the players on one hole are fairly safe from being hit by the balls of players on another hole. Sometimes golfers shout "Fore!" before they play a stroke. This warns golfers ahead of them

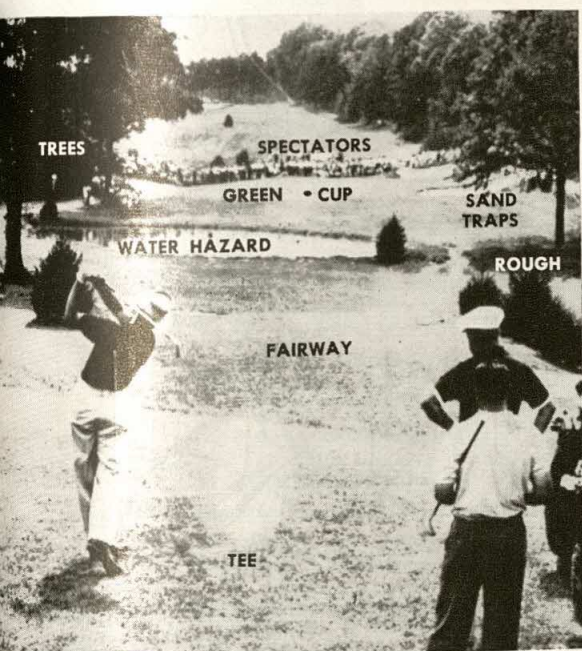
that a shot is about to be made. Most courses form a loop, bringing the golfers back to a point near the first teeing ground at the end of each round.

Golfers try to drive the ball as far as possible on long strokes. But they also must control the ball to keep it on the fairway and in a good position to approach the green. On shorter strokes, golfers try for accuracy in both direction and distance, because they want the ball to drop in the hole or stop as near it as possible. A putting green is usually laid out so that its farthest point is about 100 feet from the hole. It generally has gentle slopes, and players must allow for the slope in aiming and stroking their putts.

The Equipment includes small, hard balls and long, slender clubs. Each club is designed to play a particular type of stroke or to hit the ball a certain distance.

Golf Balls used in the United States can weigh no more than 1.62 ounces, and must measure at least 1.68 inches in diameter. The ball used in Canada and Great Britain has the same maximum weight, but it can be as small as 1.62 inches in diameter. The best balls have a small sac filled with a liquid substance, usually water or castor oil and liquid silicone. Rubber thread is wound under tension around this liquid. The thin, rubberlike cover has "dimples," or mesh markings, that increase the ball's distance and accuracy in flight.

Golf Clubs have *heads* made of wood or iron. The head is the weighted area at the end of the club that strikes

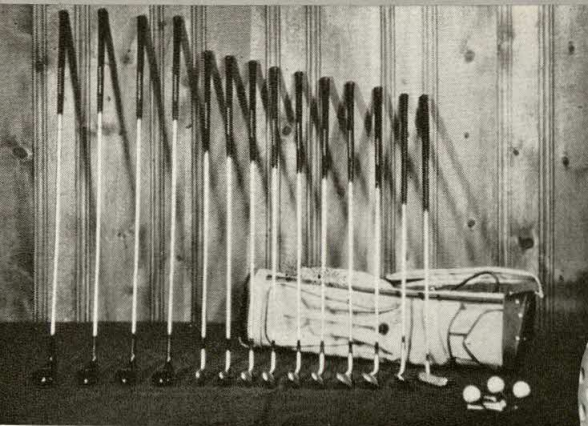


Fairway Hazards found on golf courses, left, include ponds, tree-filled roughs, and sand traps. They make it harder for a golfer to reach the green.

An 18-Hole Course might be laid out as shown below. Note that both nines start and end at the club house. Fairways with sharp bends, such as the 16th hole, are usually called dog-legs.

United Press Int.; Diagram Courtesy of Newsweek



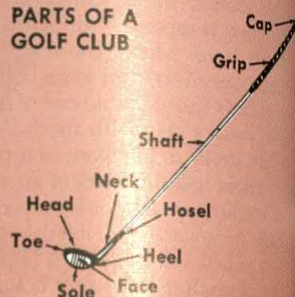


Athletic Institute; Wilson Sporting Goods Co.

Golf Equipment includes clubs, balls, tees, and a bag for the clubs. Golfers may also wear spiked shoes. A full set of clubs has four woods, nine irons, and a putter.



PARTS OF A GOLF CLUB



A Golf Ball, shown in actual size, left, has a dimpled cover that adds accuracy to flight.



1
Driver



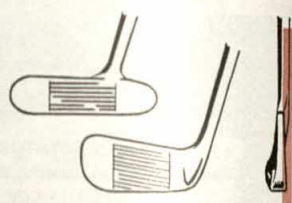
2
Brassie



3
Spoon



4
Spoon



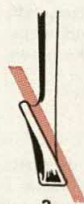
Putter

The Four Woods have little *loft*, or slope to the face of the club, and are used for long-distance shots. The driver is used to tee off and the other woods for fairway shots.

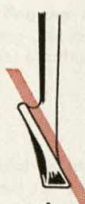
Putters are used for short, accurate shots on the green.



2
Iron



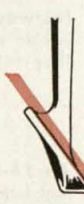
3
Iron



4
Iron



5
Iron



6
Iron



7
Iron



8
Iron



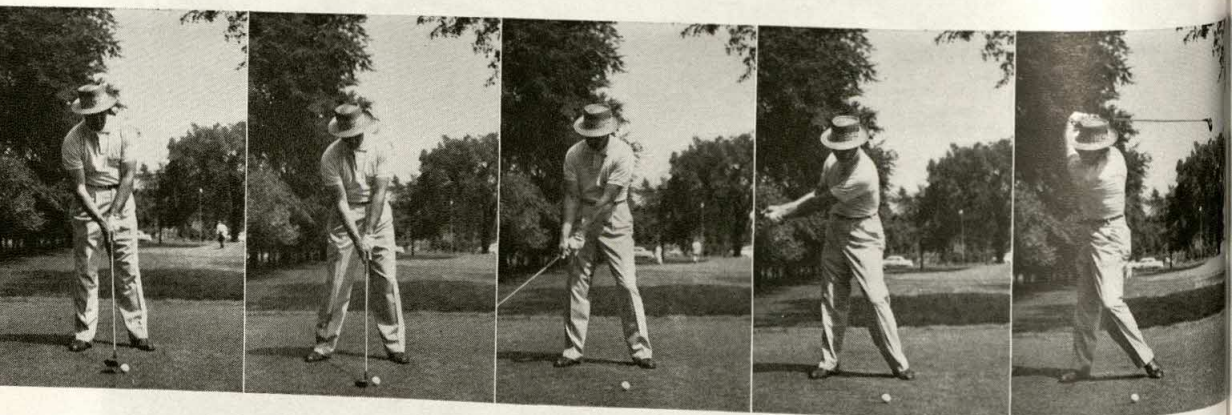
9
Iron



Wedge

Iron Clubs do not drive the ball so far as woods, but they give greater accuracy. Most of the irons have more loft than the

woods. Properly swung, they hit the ball up in the air from rough lies and can add back spin to make the ball stop on the green.



A Correct Swing is essential to hit with accuracy and distance. As demonstrated by Sam Snead, it starts, *left*, with the golfer

addressing the ball. Next, the golfer makes his backswing, shifting his weight to the back leg and cocking his wrists. As

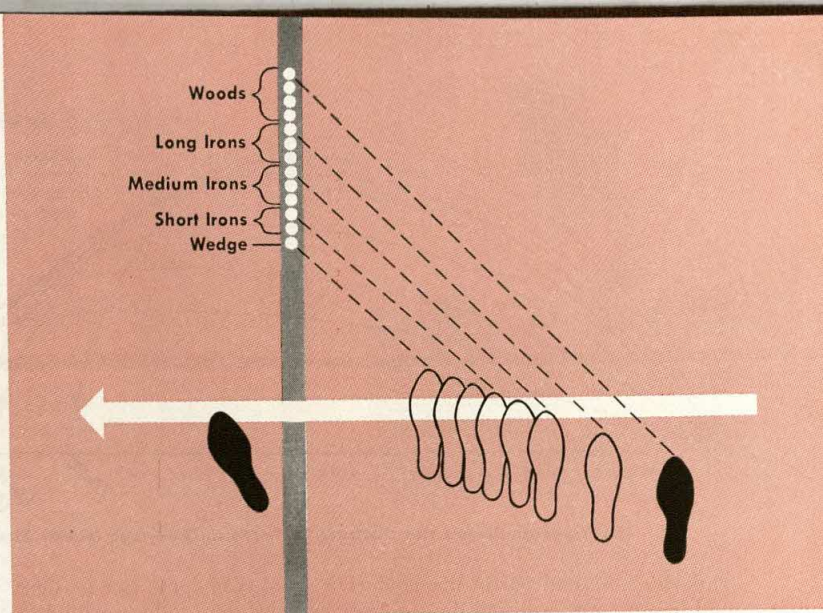


Athletic Institute

The Interlocking Grip, above, is used by many golfers. The little finger of the upper hand interlocks with the forefinger of the lower hand.

the ball. The putter is usually considered an iron club, although many putters have aluminum heads. Each club has a different angle of *loft*, or slope, on the *face*, or side, of the head that hits the ball. A relatively straight-faced club sends the ball farther than a club with a lofted face. A golfer may use a maximum of 14 clubs during a round. Beginners need only about seven clubs. Expert players usually carry 4 woods and 10 irons.

Woods have large, thick heads and comparatively little loft on their faces. Golfers use them on the teeing ground and other places where distance is required and the ball has a *good lie* (is resting high on the grass). The *No. 1 wood*, or *driver*, has the least loft of any club except the putter. Golfers use it on the teeing ground of a long hole. Experienced players can usually drive the ball about 260 yards if there is little wind and the ground is fairly level. The *No. 2 wood*, or *brassie*, has slightly more loft. Players use it for long strokes off the fairway. The *No. 3 wood* has a little more loft than the brassie, and



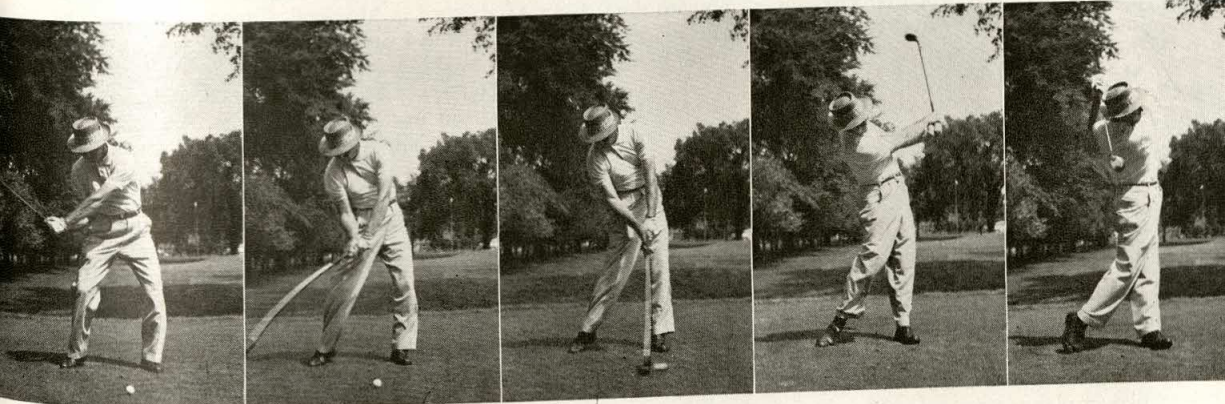
A Correct Stance is fundamental to swinging with accuracy and power. The drawing, above, shows the position of the feet for each stroke for a right-handed golfer. The left foot stays in about the same relative position to the ball. But the stance is closed to hit with the shorter clubs by moving the right foot to the left and toward the ball.

the *No. 4 wood* is lofted even more. These woods are called *spoons*. They give less distance than the *No. 2 wood*, but they are easier to use because the added loft drives the ball into the air from a poor lie.

Irons have much thinner and more bladelike heads than wooden clubs. They can cut through turf and hit the ball better from close lies. But they do not drive the ball as far as woods. Players use irons when the ball has a poor lie, or when the distance to the hole does not require the use of a wood. As the ball gets closer to the hole, the golfer uses the iron that will give him the proper distance. Most manufacturers make irons in sets numbered from 2 to 10. The *No. 4 wood*, which gives about the same distance and is easier to use, has almost completely replaced the *No. 1 iron*.

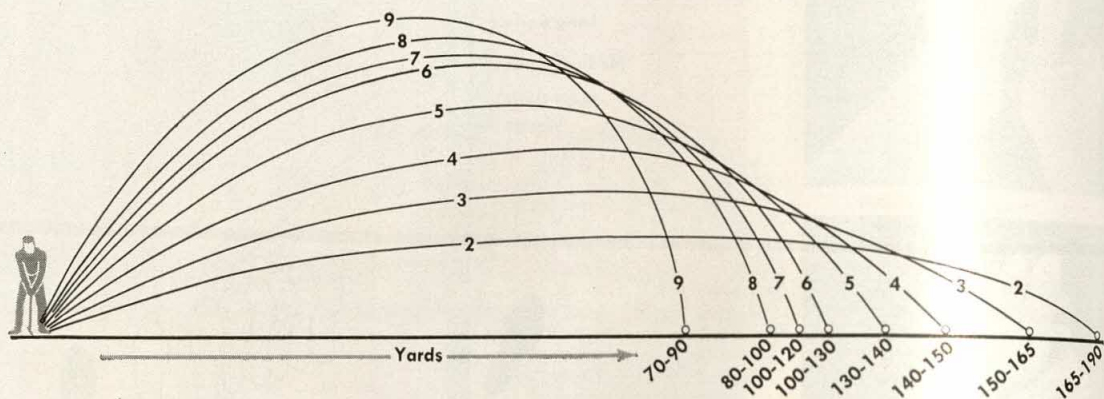
The *wedge*, usually marked *No. 10*, is the most lofted iron. Golfers use it for high, short shots, and for *explosion shots* in the sand. A golfer makes an explosion shot when he swings his wedge into the sand behind the ball and

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the golfer starts his downswing, he uncoils his body, shifting his weight forward. He uncocks his wrists to snap the club into

the ball, and follows through. The golfer must keep his eyes on the ball throughout to avoid missing or topping it.



The Diagram Shows the Distance in Yards an Average Golfer Should Reach with Each Iron.

"explodes" the ball out of the sand. The cushion of sand between the ball and the club face prevents the ball from going far.

The *putter* is generally the last club used on each hole. Putters vary in form and shape, but always have straight faces. On the green, golfers "stroke" a putt with a gentle swing of the club.

A player buys clubs that have the proper "feel" for him. He determines this by the length, weight, and flexibility of the slender club shaft. Nearly all clubs have steel shafts. They formerly had shafts made of hickory wood.

Good Form, or golfing style, can usually be learned by taking lessons or by studying the style of expert players. Every golfer must first learn to grip the club properly. The left hand uses a combination palm and finger grip on the club shaft. The right-hand grip is largely a finger grip. The two hands should form a single unit, so they can work together. The little finger of the right hand overlaps, or interlocks with, the index finger of the left hand. The golfer spreads his feet about as far apart as the width of his shoulders for long shots, and slightly closer together for shorter shots. His head remains still, and he keeps his eyes on the ball.

The Game is played in two basic ways, match play and medal play. In *match play*, the player who puts the ball in the hole in the least number of strokes wins the hole. If each player takes the same number of strokes, the hole is said to be *halved*. The player who wins the most holes wins the match. In *medal play*, the golfer with the least number of strokes in the entire round wins. Medal play is sometimes called *stroke play*.

Tournaments may be played at either match or medal play. Professionals usually compete at medal play, and amateurs at match play. When professionals and amateurs compete in the same tournament, they use medal play. In match play, the player competes against a single opponent. In medal play, the player competes against all other players taking part in that round of the tournament.

A player can be "on his own," or he may have a partner in either match or medal play. However, medal play is seldom played on a partnership basis. One player competes against another in an *individual match*. Two players play against two others, with each golfer using a different ball, in a *four-ball match*. The score for each team on each hole is the lower of the scores made by

the two partners. When two players play against two others, with each side playing alternate strokes on one ball, it is a *Scotch foursome match*. These match and medal forms of competition can be varied. One popular form of scoring, the *Nassau system*, gives a point to the winner of each 9 holes, and an additional point to the winner of the full round of 18 holes.

History

Beginnings. Golf probably developed in Scotland about 1100 from a Roman game called *paganica*. The Romans, who occupied parts of England and Scotland from about 100 B.C. to A.D. 400, played *paganica* in the open countryside with a bent stick and a leather ball stuffed with feathers. Written reports of golf date back to 1457. In that year, the parliament of King James II of Scotland banned "futeball and golfe," because their popularity threatened the practice of archery for national defense. The ban on golf ended when England and Scotland signed a treaty of "perpetual peace" in 1502.

Golfers played with a leather-covered ball stuffed with feathers, called "the feathery," until 1848. In that year a ball of solid gutta-percha, called "the gutty," was introduced (see GUTTA-PERCHA). Coburn Haskell, a Cleveland golfer, invented the present type of ball in 1899.

Early Organizations. The first permanent golf club on the American continent was the Royal Montreal Club, established in Montreal, Canada, in 1873. The first in the United States, the Foxburg (Pa.) Country Club, was established in 1887. The St. Andrews Golf Club, in Yonkers, N.Y., opened in 1888, with a six-hole course laid out in a pasture. The St. Andrews Club helped organize the United States Golf Association (U.S.G.A.) in 1894. The first stroke-play national golf championship in America was held that year in Newport, R.I. The U.S.G.A. held its first open championship tournament at Newport, R.I., in 1895. The first 18-hole course in the United States opened in 1893 at Wheaton, Ill. It was designed for the Chicago Golf Club. The first public course, in Van Cortlandt Park in New York City, opened in 1896.

Women's Golf in the United States began about two years after the Shinnecock Hills Club was founded on Long Island, N.Y., in 1896. It had a nine-hole course for women. But women had played golf in Great Britain hundreds of years earlier. Mary, Queen of Scots, may

FAMOUS TOURNAMENT CHAMPIONS

Year	U.S. Open	U.S. Amateur	U.S. Women's Amateur
1910	Alex Smith	W. C. Fownes, Jr.	D. I. Campbell
1911	J. J. McDermott	Harold H. Hilton	Margaret Curtis
1912	J. J. McDermott	Jerome D. Travers	Margaret Curtis
1913	Francis Ouimet	Jerome D. Travers	Gladys Ravenscroft
1914	Walter Hagen	Francis Ouimet	Mrs. H. A. Jackson
1915	Jerome D. Travers	Robert A. Gardner	Mrs. C. H. Vanderbeck
1916	Charles Evans, Jr.	Charles Evans, Jr.	Alexa Stirling
1917-18	No tournaments		
1919	Walter Hagen	S. D. Herron	Alexa Stirling
1920	Edward Ray	Charles Evans, Jr.	Alexa Stirling
1921	James M. Barnes	Jesse P. Guilford	Marion Hollins
1922	Gene Sarazen	Jess W. Sweetser	Glenna Collett
1923	R. T. Jones, Jr.	Max R. Marston	Edith Cummings
1924	Cyril Walker	R. T. Jones, Jr.	Mrs. D. C. Hurd
1925	W. Macfarlane	R. T. Jones, Jr.	Glenna Collett
1926	R. T. Jones, Jr.	George Von Elm	Mrs. G. H. Stetson
1927	Tommy Armour	R. T. Jones, Jr.	Mrs. M. B. Horn
1928	Johnny Farrell	R. T. Jones, Jr.	Glenna Collett
1929	R. T. Jones, Jr.	H. R. Johnston	Glenna Collett
1930	R. T. Jones, Jr.	R. T. Jones, Jr.	Glenna Collett
1931	Billy Burke	Francis Ouimet	Helen Hicks
1932	Gene Sarazen	C. R. Somerville	Virginia Van Wie
1933	John Goodman	G. T. Dunlap, Jr.	Virginia Van Wie
1934	Olin Dutra	W. Lawson Little, Jr.	Virginia Van Wie
1935	Sam Parks, Jr.	W. Lawson Little, Jr.	Glenna Collett Vare
1936	Tony Manero	John W. Fischer	Pamela Barton
1937	Ralph Guldahl	John Goodman	Mrs. J. A. Page, Jr.
1938	Ralph Guldahl	Willie Turnesa	Patty Berg
1939	Byron Nelson	Marvin H. Ward	Betty Jameson
1940	W. Lawson Little, Jr.	R. D. Chapman	Betty Jameson
1941	Craig Wood	Marvin H. Ward	Mrs. Frank Newell
1942-45	No tournaments		
1946	Lloyd Mangrum	Ted Bishop	Mildred "Babe" Didrikson
1947	Lew Worsham	Robert Riegel	Louise Suggs
1948	Ben Hogan	Willie Turnesa	Grace Lenczyk
1949	Cary Middlecoff	Charles Coe	Mrs. D. G. Porter
1950	Ben Hogan	Sam Urzetta	Beverly Hanson
1951	Ben Hogan	Billy Maxwell	Dorothy Kirby
1952	Julius Boros	Jack Westland	Mrs. Jacqueline Pung
1953	Ben Hogan	Gene Littler	Mary Lena Faulk
1954	Ed Furgol	Arnold Palmer	Barbara Romack
1955	Jack Fleck	Harvie Ward	Patricia Lesser
1956	Cary Middlecoff	Harvie Ward	Marlene Stewart
1957	Dick Mayer	Hillman Robbins	Joanne Gunderson
1958	Tommy Bolt	Charles Coe	Anne Quast
1959	Bill Casper, Jr.	Jack Nicklaus	Barbara McIntire
1960	Arnold Palmer	Deane Beman	Joanne Gunderson



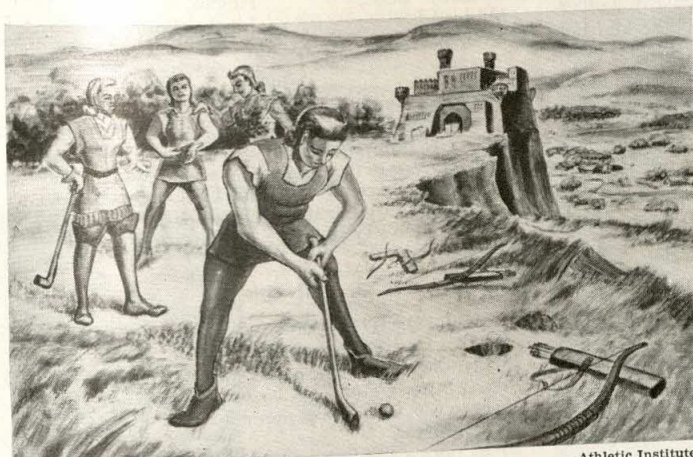
Wilson Sporting Goods Co.

"Slamming" Sammy Snead, above, ranks among the all-time great professional golfers.



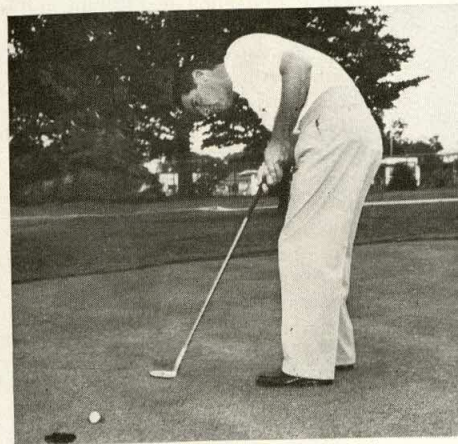
Wilson Sporting Goods Co.

Patty Berg, shown chipping onto a green, became one of the top American woman golfers.



Athletic Institute

Golf Probably Originated in Scotland about 1100 from a Roman game called *paganica*. Early golfers used bent sticks and a feather-stuffed leather ball.



Wilson Sporting Goods Co.

Cary Middlecoff, above, shows the putting skill that made him a top professional golfer.

GOLF

have been the first woman player. She used the word *cadet*, or pupil, for a person who carried the golf clubs for a player. This word later became *caddy* or *caddie*.

Golf Associations. The United States Golf Association was founded on Dec. 22, 1894. It makes the rules used in the United States, and conducts major tournaments. It does not allow any player who profits financially from golf to remain an amateur. Golfers in Canada and most other countries follow rules set by the Royal and Ancient Club of St. Andrews, Scotland.

The Professional Golfers' Association (P.G.A.) was founded in 1916. It has about 6,000 members. About 100 of these golfers are *playing professionals*, who earn their living chiefly by winning prize money in tournaments. The rest are *club professionals*, who give lessons at golf clubs and sell equipment.

Principal Tournaments in the United States include the U.S.G.A. Open, the U.S.G.A. Amateur, and the Masters. Both amateur and professional golfers compete in the *U.S.G.A. Open* or *U.S. Open*. The *U.S.G.A. Amateur*, or *U.S. Amateur*, is the major tournament for amateur golfers. The U.S.G.A. also holds open and amateur tournaments for women players. The *Masters tournament*, one of the most famous golfing events, is held annually at the Augusta (Ga.) National Golf Course.

International Matches. Amateur teams representing the United States and Great Britain compete in the *Walker Cup* series, the oldest international team match. G. Herbert Walker, then president of the U.S.G.A., presented the cup for the series, which started in 1922. Eight-man teams, selected by the U.S.G.A. and the Royal and Ancient Golf Club, compete every other year. The series is played alternately in the United States and Great Britain.

Professional eight-player teams from the United States and Great Britain compete for the *Ryder Cup*. The professional golfers' associations of the two nations choose the teams. The tournament is held every other year, alternating between the countries. The series started in 1926. Samuel Ryder of England presented the cup.

The *Curtis Cup* is the only women's international match. It features six-woman amateur teams from the United States and Great Britain, and is held every other year, with the site alternating. Harriet Curtis and her sister Margaret, who won a total of four U.S.G.A. Women's Amateur titles, donated the cup. Competition began in 1930.

The *Americas Cup* competition started in 1952. Six-man amateur teams from the United States, Canada, and Mexico play every other year in one of the three countries. The U.S.G.A., Royal Canadian Golf Association, and the Asociación Mexicana de Golf pick the teams. Jerome P. Bowes, a president of the Western Golf Association, presented the cup.

Six-man professional teams representing the United States and Canada compete every year in Canada for the *Hopkins Cup*. The series began in 1952 for a cup donated by John Jay Hopkins.

Golf Immortals

For separate biographies of the most famous golfers, see the *Related Articles* at the end of this article. The following list includes short biographies of other great

sportsmen who have won fame as golfers.

Ball, John (1861-1940), the first great amateur golfer, won the British amateur title eight times between 1888 and 1912. He was born in Holylake, England.

Berg, "Patty," Patricia (1913-), one of the greatest women golfers, won the U.S. Women's Amateur title in 1938, the U.S. Women's Open in 1946, and many other tournaments. She was born in Minneapolis, Minn.

Hilton, Harold (1868- ?), was perhaps the greatest English amateur golfer. He won the British Open in 1892 and 1897; the British Amateur in 1900, 1901, and 1911; and the U.S. Amateur in 1911. He was born in West Kirby, Cheshire, England.

Morris, "Tom," Thomas, Sr. (1821-1908), was keeper of the green for the Royal and Ancient Golf Club at St. Andrews, Scotland. He won four British Open titles between 1861 and 1867. He was born at St. Andrews.

Nelson, (John) Byron (1911-), a great American professional golfer, won the U.S. Open in 1939, the Masters in 1937 and 1942, and the P.G.A. title in 1940 and 1945. He was born near Fort Worth, Tex.

Ouimet, Francis (1893-), at the age of 20, became the first amateur to win the U.S. Open title in 1913. He won the U.S. Amateur title twice. In 1951, Ouimet became the first American to be elected captain of the Royal and Ancient Golf Club of St. Andrews, Scotland. He was born in Brookline, Mass.

Sarazen, Gene (1902-), won the U.S. Open in 1922 at the age of 20, and again in 1932. He won the Masters in 1935, and the P.G.A. title in 1922, 1923 and 1933. Sarazen was born at Harrison, N.Y.

Snead, "Sam," Samuel Jackson (1912-), one of the greatest professional golfers, won the Masters in 1949, 1952, and 1954; the P.G.A. in 1949 and 1957; and the British Open in 1946. He was born at Hot Springs, Va.

Van Wie, Virginia (1909-), won the U.S. Women's Amateur three straight times, from 1932 through 1934. She had taken up golf on the orders of her doctor. She was born in Chicago, Ill.

Vardon, Harry (1870-1937), won the British Open title six times between 1896 and 1914. He also won the U.S. Open in 1900. He introduced the overlapping grip. Vardon was born at Grouville, Jersey, England.

Vare, Glenna Collett (1903-), won six U.S. Women's Amateur titles between 1922 and 1935. She was born in New Haven, Conn.

Withered, Joyce (? - ?), one of the greatest women golfers in history, was noted for her classic style. She won the British Women's title four times between 1922 and 1929.

E. CARY MIDDLECOTT

Related Articles in WORLD BOOK include:

Didrikson, "Babe," Hogan, Ben
Mildred E. Jones, "Bobby," Robert T.
Hagen, Walter

Outline

- I. How to Play Golf
 - A. The Course
 - B. The Equipment
 - C. Good Form
 - D. The Game
- II. History
 - A. Beginnings
 - B. Early Organizations
 - C. Women's Golf
 - D. Golf Associations
 - E. Principal Tournaments
 - F. International Matches
- III. Golf Immortals

Questions

- How did the term *caddy* originate?
What is *loft*? How does it affect the game?
When does a golfer use a *wood*? An *iron*? A *putter*?
What is *par*? A *divot*? A *birdie*? A *bogey*?
Where was the first permanent golf club on the American continent?
Why does a golf ball have "dimples"?
What is the fairway?
How do the American and British golf balls differ?
How many clubs may a player carry during a round?

GOLGI, GAWL jih, CAMILLO (1844-1926), an Italian anatomist and pathologist, shared the 1906 Nobel prize in medicine and physiology for his studies on the structure of the nervous system. In 1873, he developed a method of staining tissues with silver nitrate for microscopic study. He later discovered the "Golgi Cells" and described the nerve endings in tendons and muscles. In 1886, he demonstrated the life cycle and structure of malarial parasites. Golgi was born in Corteno, Italy, July 7, 1844.

HENRY H. FERTIG

GOLGOTHA. See CALVARY.

GOLIARD. See LITERATURE (Middle Ages).

GOLIATH, goh LIE uth, was a Philistine warrior almost 10 feet tall. He defied the Israelite army to send a champion to fight him. Young David, armed with only a slingshot, volunteered. David, confident that he upheld God's honor, shot his first stone straight into Goliath's forehead. David then toppled the giant to the ground and chopped off his head. The story is told in the Bible at I Samuel 17.

GLEASON L. ARCHER, JR.

See also DAVID; GATH.

GOLDSCHMANN, GOHLSH mahn, VLADIMIR (1893-), a French-American conductor, conducted the St. Louis Symphony Orchestra from 1931 to 1957. He was born in Paris, and in 1919 founded the Concerts Golschmann, which introduced much modern music. Golschmann made his American debut in 1924 as guest conductor of the New York Symphony Orchestra.

GÓMEZ, JUAN VICENTE. See VENEZUELA (Early 1900's).

GOMORRAH. See SODOM.

GOMPERS, SAMUEL (1850-1924), an American labor leader, was the first president of the American Federation of Labor. From 1886 until his death, he missed only one year, 1895, as president. His was perhaps the most important personal influence in shaping the AFL (see AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS).

Gompers insisted that unions should rely on bargaining with employers, and avoid ties with government and political parties. He campaigned vigorously to get rid of the labor injunction issued by courts to curb strikes. He worked hard for provisions in the Clayton Antitrust Act of 1914, which he hailed as labor's "Magna Carta" (see TRUST [Trust Legislation]). Gompers supported labor laws aimed at regulating the conditions and hours of work of women and minors. He was influential in the national legislation that established the United States Department of Labor.

Samuel Gompers

Ewing Galloway



Gompers was born in London. He moved to the United States when he was 13. A year later he became the first registered member of the Cigar-Makers' International Union. He made this organization one of the most successful trade unions.

JACK BARBASH

GOMULKA, go MOOL kuh, WLADYSŁAW (1905-), became the leading political figure in Poland in 1956 as First Secretary of the United Polish Workers'

GONDOLA CAR

(Communist) party. He led a revolution in October, 1956, which won for Poland more independence from Russia.

Gomulka headed the Polish Communist party after World War II. He was removed from this position and imprisoned without trial from 1951 to 1956 because he opposed Joseph Stalin's control of Polish affairs. Gomulka was born in Krosno.

CHARLES MORLEY

GONAD. See GLAND (The Sex Glands); HORMONE (Some Important Hormones).

GONDOLA, GAHN doh luh, is a long, slender boat that floats silently along the canals of Venice. An old law requires all gondolas, except those that belong to high officials, to be painted black. The *gondolier* pushes the boat through the water with a long sweep, or narrow-bladed oar. Today in Venice, gasoline launches have replaced gondolas for light freight transport. But the gondola is still the tourists' favorite for sightseeing and quiet rides.

JOHN J. FLOHERTY

See also VENICE.

GONDOLA CAR. See COAL (Shipping); RAILROAD (Freight Cars; color picture, Types of Freight Cars).

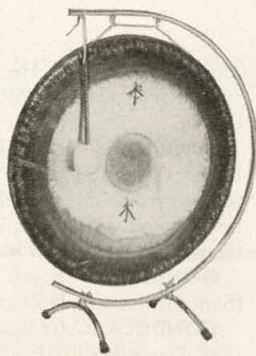
Gondolas carry many passengers up and down the canals of Venice. Gondoliers keep their water "taxis" shiny and clean with black polish, and cover them at night to keep out the rain.

United Press Int.





Courtesy of The Metropolitan Museum of Art, gift of Mrs. John Crosby Brown, 1889.



Ludwig Drum Co.

Symphonic Gongs of today have a deep tone. This one is copied from a Chinese gong.

Siamese Temple Gongs are used during religious dances.

GONG is a percussion musical instrument, that is struck to make a sound. It is mentioned in Chinese writings as early as the A.D. 500's. The instrument probably originated in the area around Burma and Tibet. Most gongs are made of bronze, and are usually round and flat. Musicians hang them from a stand and strike them with a hammer or mallet. Gongs vary in size, pitch, and tone. The gongs used in Oriental temples are usually large, and have deep tones. Musicians of India, Malaya, China, and Indonesia use smaller, tinkling gongs. Gongs were brought to Europe in the late Middle Ages. Symphony orchestras and jazz bands often use them now. Hand and electric gongs serve as fire and burglar alarms, and as signals in schools, offices, and factories.

CHARLES B. RIGHTER

GONORRHEA. See VENEREAL DISEASE.

GONZAGA, SAINT ALOYSIUS (1568-1591), was an Italian Roman Catholic saint. He was the son of the feudal lord of Castiglione, and was educated at the courts of Francesco de' Medici in Florence and of King Philip II of Spain. He entered the Jesuit order in Italy in 1585. He gained great fame during his lifetime for his brilliance as a scholar of philosophy and theology. He died in 1591 while caring for the sick during a famine and plague in Italy. He was canonized by Pope Benedict XIII in 1726, and his feast day is June 21. Gonzaga University in Spokane, Wash., is named for this saint.

FULTON J. SHEEN

GONZAGA UNIVERSITY is a coeducational Roman Catholic university conducted by the Jesuits at Spokane, Wash. It offers courses in liberal arts, law, engineering, nursing, education, and economic and business administration. All courses of study require a liberal arts curriculum. The university's library has special collections of the works of Pierre Jean De Smet and Gerard Manley Hopkins. Courses lead to bachelor's and master's degrees. Gonzaga was founded in 1887. For enrollment, see UNIVERSITIES AND COLLEGES (table).

GONZALES, "PANCHO," RICHARD. See TENNIS (Famous Tennis Players).

GONZALO DE CÓRDOBA, gohn THAH loh day KAWR thoh vah, **HERNÁNDEZ** (1453?-1515), was a Spanish general. He served in the wars against Portugal and the Moors. He was viceroy of Naples until 1506, when King Ferdinand V, who resented his popularity, recalled him from this position. Gonzalo was born in Montilla, Spain.

FRANKLIN D. SCOTT

GOOBER. See PEANUT.

GOOD AND EVIL constitute one of man's most fundamental contrasts. In evaluating the world in which we live, we treat good and evil as *cosmic principles*, or opposing forces in the universe. In evaluating human actions, we consider good and evil as *moral traits*.

Several philosophers, including the Persians Zoroaster and Manes, have held that good and evil are cosmic principles or opposing forces in the universe. This view states that the perpetual struggle between these principles accounts for the alternations in nature and in human affairs. Saint Augustine, the great Roman Catholic theologian, denied that evil is a positive reality or that God produces evil. He and other theologians who hold this view have stated that the universe is basically good. They say that evil results from some privation or from human choice.

When morally viewed, good and evil are traits of free human actions and their objects. From experience, we know that some actions are harmful to us as individuals or as members of the society in which we live. We also know from experience that other actions enhance our lives and satisfy our needs. Those actions which help to perfect our nature are termed *good*. Those which impede this process and keep us from attaining rounded well-being are termed *evil*.

JAMES COLLINS

See also PHILOSOPHY (What Is Good and What Is Evil?).

GOOD CONDUCT MEDAL. See DECORATIONS AND MEDALS (United States Service Medals).

GOOD COUNSEL COLLEGE is a liberal arts college for women at White Plains, N.Y. It is a Roman Catholic school, conducted by the Sisters of the Divine Compassion. The college was founded in 1923. For enrollment, see UNIVERSITIES AND COLLEGES (table).

GOOD FRIDAY is the Friday before Easter, mourned as the anniversary of Christ's death on the cross. It was set apart as a holy day as long ago as the 300's, in the time of Constantine. In Great Britain and Ireland the day is a legal holiday, and in Anglican, Roman Catholic, and some Protestant churches a three-hour service is held to recall the agony of Christ on the cross. In some countries of Europe, bells are tied on Good Friday so that they cannot ring.

ALBERT E. AVEY and FULTON J. SHEEN

GOOD HOPE, CAPE OF. See CAPE OF GOOD HOPE.

GOOD NEIGHBOR POLICY. See PAN AMERICAN CONFERENCES; LATIN AMERICA (Relations with the United States).

GOOD QUEEN BESS. See ELIZABETH I.

GOOD TEMPLARS, INTERNATIONAL ORDER OF, is a fraternal organization founded in Utica, N.Y., in 1851, to promote temperance, peace, and brotherhood. The order has lodges in the United States and many other countries. Membership is open to all, regardless of race, color, or creed. The order works with temperance groups, but is not affiliated with any of them. National headquarters of the Good Templars are at 10219 S. Union Ave., Chicago, Ill.

MARTHA V. PALMGREN

GOOD WILL indicates the popularity of a firm with its customers, or the *good will* the customers have toward the firm. It covers the worth of a business concern beyond the value of its capital, property, stock, or funds. Good will is measured by the amount of net profits a firm makes above the expected average return on the capital investment. A favorable location, good merchandise, and a reputation for fair dealing in both buying and selling help to create good will. A buyer of a firm's good will usually requires that he may call himself the firm's successor. The seller usually agrees not to engage in the same business for a certain period of time or in the same locality.

JOHN H. FREDERICK

GOODFELLOW, ROBIN. See **BROWNIE**; **PUCK**.

GOODHUE, BERTRAM GROSVENOR (1869-1924), was an American architect. He worked from 1895 to 1913 with Ralph Adams Cram. Together they produced such masterpieces as the United States Military Academy buildings, Saint Thomas' Church in New York City, and the First Baptist Church in Pittsburgh, Pa. After 1913, Goodhue practiced independently. His outstanding achievements were the Los Angeles Public Library and the Nebraska state Capitol.

HUGH MORRISON

GOODING, FRANK R. See **IDAHO** (Famous Idahoans).

GOODMAN, "BENNY," BENJAMIN D. See **JAZZ**.

GOODRICH, BENJAMIN FRANKLIN (1841-1888), founded the rubber industry in Akron, Ohio. A real estate transaction in 1867 made him part-owner of a small rubber factory in New York City. It was unsuccessful, but he had confidence in the future of rubber. He moved to Akron in 1870. He established the B. F. Goodrich Company on a sound financial basis in 1880.

Goodrich was born in Ripley, N.Y. He studied medicine and served as an army surgeon. He gave up medicine in 1865.

KENNETH W. PORTER

GOODRICH COMPANY, B. F. See **RUBBER** (Leading Rubber Manufacturers).

GOODSPEED, EDGAR JOHNSON (1871-), is an American Bible scholar. He did archaeological exploring in the Holy Land. His major work was to show that the Greek in which the New Testament was first written was the daily language used during the time of Jesus. He showed that the language was not, as had been supposed, established especially for literary purposes. Goodspeed wrote *The New Testament: An American Translation* (1923), and many books to explain the Bible. He published *Twelve*, the story of Christ's apostles, in 1957. He was born in Quincy, Ill., and studied at Denison University, Yale, Chicago, and European universities.

EDWIN H. CADY

GOODWILL INDUSTRIES OF AMERICA, INC., is an organization that provides training, employment, and rehabilitation services for handicapped people. Goodwill Industries are located in 120 United States cities, and are also found in Canada and Mexico. Handicapped persons repair and recondition clothing and household articles given to the Industries. These articles are then sold to the public. Many Goodwill Industries also offer work to handicapped persons on jobs contracted from private businesses. Their rehabilitation services depend on their available resources and community needs. E. J. Helms, a Methodist minister, founded the Goodwill Industries in Boston in 1902. National headquarters are at 1913 N St. N.W., Washington 6, D.C.

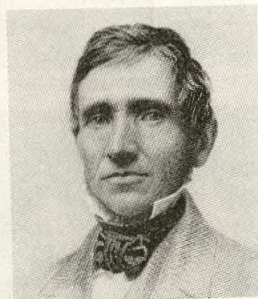
PERCY J. TREVETHAN

GOONEY BIRD

GOODWIN, JOHN N. See **ARIZONA** (Famous Arizonans).

GOODYEAR is the name of an American family that has been prominent in industry and the arts.

Charles Goodyear (1800-1860) discovered the process of vulcanizing rubber. In 1834, while he was in prison for debt, he made his first attempts to change natural rubber into a useful product. After many failures, he first successfully vulcanized rubber in 1839. He accidentally dropped some rubber mixed with sulfur on a hot stove. The rubber did not melt as expected. Using this as a lead, Goodyear worked on the process until he perfected it. See **RUBBER** (Discovery of Vulcanization; Vulcanization).



Brown Bros.

Charles Goodyear

Goodyear gained little financially from his discovery. Poor health and debts plagued Goodyear during much of his life, and he was frequently poverty-stricken. He licensed his process to manufacturers at low rates, and became involved in several much-publicized infringement suits. Goodyear was born on Dec. 29, 1800, in New Haven, Conn.

Charles Goodyear, Jr. (1833-1896), the eldest son of Charles Goodyear, was associated for a time with his father. But he soon became interested in adapting the sewing machine to the manufacture of shoes, and became a successful manufacturer of shoe machinery. He was born in Germantown, Pa.

William Henry Goodyear (1846-1923), another son of Charles Goodyear, was a noted art historian and archaeologist. He wrote widely on these subjects and directed the department of fine art at the Museum of the Brooklyn Institute of Arts and Sciences from 1890 until his death. He was born in New Haven, Conn., and was graduated from Yale University.

JOHN B. MCFERRIN

GOODYEAR, MILES (1817-1849), an American pioneer and fur trader, built the first settled homestead in Utah in about 1845. He was born in Connecticut, and spent his boyhood there. He then moved to the frontier, where Marcus Whitman found him in a destitute condition (see **WHITMAN, MARCUS**). He later became associated with mountain fur traders and explored the territory around Salt Lake. The Mormons bought Goodyear's property in 1848, and he moved to southern California.

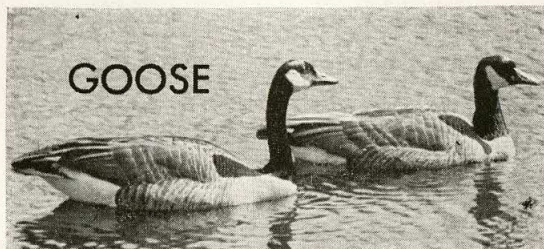
THOMAS D. CLARK

GOODYEAR TIRE & RUBBER COMPANY. See **RUBBER** (Leading Rubber Manufacturers).

GOOGOL, *GOO gul*, is the number written as 1 followed by a hundred zeros, or 10^{100} . The term has also come to mean any very large number. A *googolplex* is an even larger number than a googol. It is 10 to the googol power, or 10 multiplied by itself a googol number of times. The term *googol* was introduced by the American mathematician Edward Kasner, whose 9-year-old nephew first used it.

GOONEY BIRD. See **ALBATROSS** (picture).

GOOSE



GOOSE is a web-footed bird closely related to the duck and swan. It is larger than a duck and smaller than a swan. About 25 kinds of geese live in various parts of the world. Thirteen kinds of wild geese live in the United States and Canada. These geese range from 20 to 40 inches long, and have wide wings. They are all *migratory* birds, flying north in summer and south in winter. Some of them fly as far north as the Arctic Circle, and some as far south as Mexico.

Appearance and Habits. The goose's neck is a little longer than that of a duck, and not so gracefully curved as a swan's. Geese are good swimmers. They can walk on land better than either swans or ducks, because their legs are longer and nearer the middle of their bodies. Heavy layers of down underlie their dense plumage. Geese rub their feathers with an oil produced by a gland near their tails. This oil waterproofs their bodies. But oil from oil slicks created by ships on inland water may soak their feathers so that the geese are not able to fly and sometimes starve. Geese have long lives and sometimes reach more than 30 years of age in captivity.

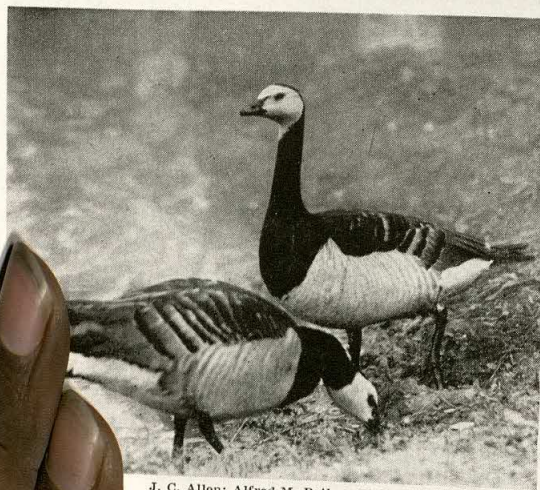
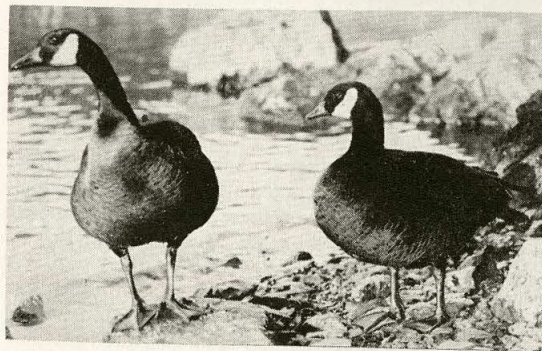
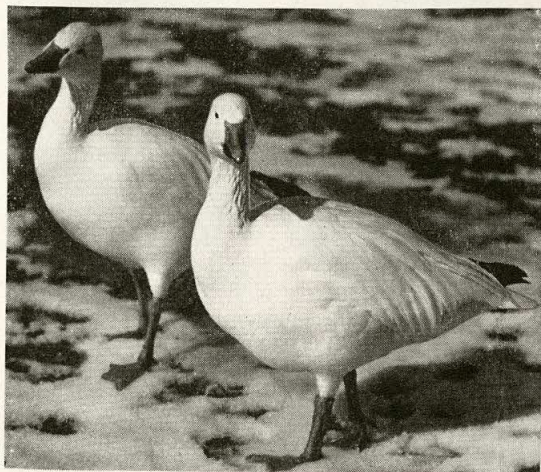
Geese fly in groups, often in great V-shaped formations. They fly rapidly, honking loudly, and have been known to fly as high as 29,000 feet above sea level.

Geese usually eat grains and vegetables, and sometimes insects and small water creatures. In some regions, they do much harm to the wheat crop. Farmers often hire men to keep them away. Geese are cautious, intelligent, and difficult to hunt. Some feed only in wide stretches of water, marshes, or fields where hunters find it difficult to hide. A few members of the flock seem to stand guard against any possible danger while the remainder of the flock feeds.

Many geese nest in shallow holes in the ground, which they line with grass, feathers, and down. Geese usually lay from three to six white eggs. Wild goose eggs are sometimes hatched under a hen. But a hen can cover only three of the large eggs. The young are tame and amusing in the barnyard with their proud, bold ways.

Wild Geese. The *Canada goose* is the best-known goose of North America. It has a broad white band across its throat and cheeks. It ranges from Labrador and the Arctic Ocean to Mexico. The Canada goose builds its nest on a low mound in a marsh. The nest is made of grass and leaves and lined with down. The *blue goose* has a bluish-gray body and a white head. Blue geese breed in the Arctic islands, and spend the winter in a restricted area on the coast of Louisiana. The blue goose is closely related to two kinds of *snow geese*, which are white birds with black wing-tips. Snow geese range from the Arctic coast of northeastern Asia and of North America to lower California and Mexico. Another kind of goose, the *brant*, is a salt-water bird. It breeds on the Arctic islands and on the coast of Greenland, and migrates south to the eastern coast of the United States. A closely related bird, the *black brant*, lives on the Pacific Coast.

Domestic Geese. Farmers raise many geese in their barnyards. These tame geese rank among the most



The Wild Geese Best Known to Hunters in North America are cunning Canada geese, *left top*. Other wild geese found in the United States and Canada include snow geese, *second*, white-cheeked geese, *third*, and white-faced barnacle geese, *bottom*.

intelligent of the many kinds of domesticated birds. For this reason, children who live on farms sometimes enjoy keeping geese as pets.

Domestic geese are the descendants of the *graylag* goose of Europe. They grow much larger than their wild ancestors, but have almost lost the ability to fly. They can take only short hops in the air. Domestic breeds include the *Toulouse*, colored gray, and the *Emden*, which is white with an orange bill. The brown *Chinese* goose has a black bill and a yellow stripe on its neck. Another goose of light gray color is called the *African* goose, because of its black head.

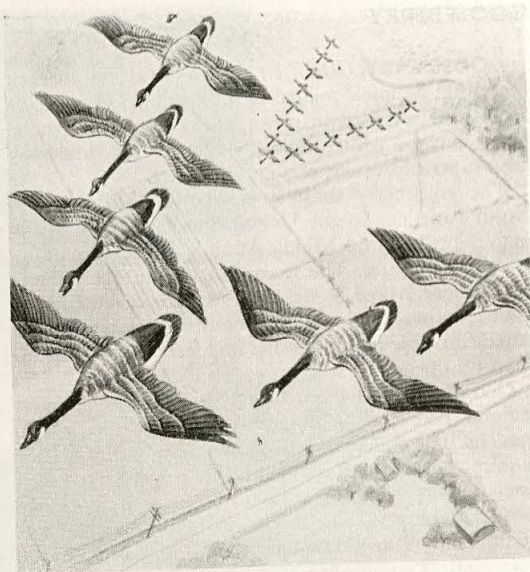
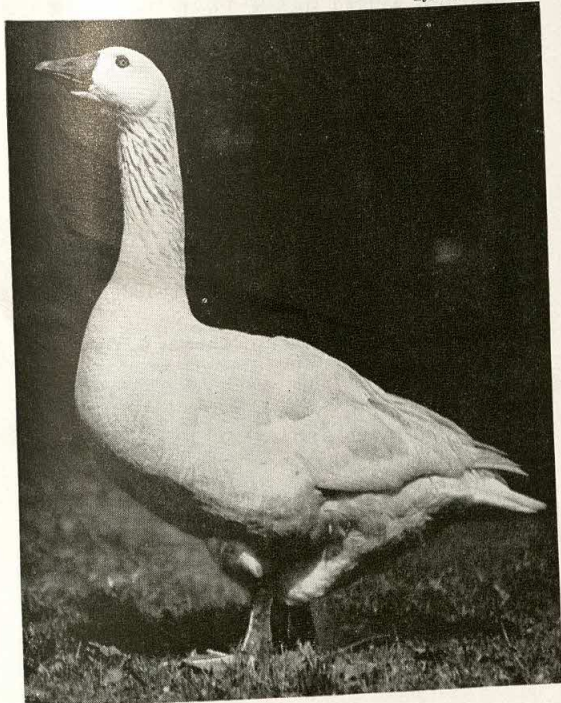
Domestic geese mate for life. Before the female lays eggs, the pair make a nest that the female lines with down from her breast. The male shows great interest in the young while they are being hatched and raised.

The raising of geese has greater importance in Europe than in the United States. In Europe, especially in Germany, farmers keep large flocks of geese that provide a valuable source of income. Goose feathers furnish down to stuff pillows and quilts. Goose eggs and flesh are eaten. A delicately flavored pastelike food called *pâté de foie gras* is made from the livers of fattened geese. Some European farmers use electric machines to feed their geese. The machine forces a stream of corn into the bill of each goose two or three times a day for about a month. This not only fattens the goose, but also enlarges its liver quickly.

History and Literature. One of the most interesting stories of early Roman history tells how sacred geese in the Temple of Juno saved the city. In 390 B.C., the

The Goose of the Barnyard first came from Europe. It is one of the proudest birds in the animal kingdom. In Central Europe, geese are driven to market on foot. They are driven over sticky tar, then across some sand. The sand sticks to the tar and protects their tender webbed feet along the way.

Lynwood M. Chace



Wild Geese sometimes fly in a V-shaped formation when moving to or from their breeding grounds in the Far North. The goose at the apex of the triangle apparently is the leader of the flock.

Gauls, a fierce northern people, attacked the Romans. The invaders drove the Romans to a steep rocky hill known as the Capitol, which was used as a fort. One night, the consul Manlius was awakened by the cackling of the sacred geese. Rushing to the wall, he saw that the Gauls had almost climbed it. His shouts and the noise of the geese woke the other Romans, and they defeated the Gauls.

A well-known fable tells the story of the goose that laid the golden egg. Every day it laid one egg. The greedy master cut the goose open to find the gold. But he found nothing for his greed, and got no more eggs. See **AESOP'S FABLES** (picture).

Scientific Classification. Geese make up the subfamily *Anserinae* in the family *Anatidae*. The Canada goose is genus *Branta*, species *canadensis*. The snow goose is genus *Chen*, species *hyperborea*.
JOSEPH J. HICKEY

Related Articles in **WORLD BOOK** include:

Bird (color picture, Wild Ducks and Wild Geese)	Feather Pen
Brant	Poultry
Canada Goose	Swan

GOOSE BAY is a large military air base covering about 120 square miles in southeastern Labrador. It lies at the head of Lake Melville, a salt-water inlet almost 200 miles from the Atlantic Ocean. For location, see **NEWFOUNDLAND** (color map).

The air base was built in 1942, during World War II. American military planes bound for Europe used it as a take-off point. Today, the Royal Canadian Air Force has charge of the main airfield. The U.S. Air Force operates another field, under lease from Canada. Commercial aircraft which usually use Gander Airport refuel at Goose Bay when fog prevents them from landing at Gander.

Goose Bay personnel live in nearby towns, including Happy Valley on the banks of the Hamilton River, four miles from Goose Bay.

FRED W. ROWE

GOOSEBERRY

GOOSEBERRY, *GOOZ ber ry*, is an oval, tart fruit, or berry that is closely related to the currant. Gooseberries are commonly used in preserves and pies. The gooseberry may be white, yellow, green, or red, and may have a prickly, hairy, or smooth surface.

The gooseberry shrub grows both in Europe and North America. In the United States it grows chiefly in the North Central, Middle Atlantic, Rocky Mountain, and Pacific states. The European varieties bear larger and better-flavored berries than the American. In England, improved varieties yield berries as large as plums. American varieties are hardier and less likely to mildew than European.

Gooseberry shrubs grow well in shady, cool, moist regions. People often plant them under fruit trees in gardens. The shrubs can be grown from cuttings. They require cool and well-drained soil of a heavy type such as clay loam. The shrubs should be planted about five feet apart in rows. The rows may be six to eight feet apart. The soil should be firm about the roots.

Scientific Classification. Gooseberries belong to the family *Saxifragaceae*. The American gooseberry is genus *Ribes*, species *hirtellum*. The European is classified as *R. grossularia*.

ROY E. MARSHALL

See also **CURRENT**; **SAXIFRAGE**.

Leaves and Fruit of the Gooseberry Bush. Depending on the variety, the fruits may be white, yellow, green, or red.

L. W. Brownell



GOOSEFOOT. See **LAMB'S-QUARTERS**.

GOOSENECKS OF THE SAN JUAN RIVER. See **UTAH** (Interesting Places to Visit).

GOOSSENS, *GOOS unz*, **SIR EUGENE** (1893-), is a British conductor and composer. He conducted the Cincinnati Symphony Orchestra from 1931 to 1946. For the next 10 years he was resident conductor of the Sydney (Australia) Symphony Orchestra and director of the New South Wales Conservatorium. He composed a *Sinfonietta* and two symphonies for orchestra, and two operas. Goossens was born in London. **DAVID EWEN**
G.O.P., the Grand Old Party. See **REPUBLICAN PARTY**.

GOPHER, *GO fur*, is a small American rodent, or gnawing animal, that burrows in the ground. It lives from Illinois, Florida, and the Gulf of Mexico west to the Pacific Coast, and from the Saskatchewan River district south to Panama. French settlers noticed how its burrows honeycombed the soil. They named it from the French word *gaufre*, meaning *honeycomb*. Because of the fur-lined pouches in its cheeks, naturalists call it *pocket gopher*.

A gopher is slightly heavier than a common house rat. The different species vary somewhat in size, but they all have about the same shape. A gopher has a broad blunt head with almost no neck, small ears, short legs, and small eyes. Its color varies from reddish-brown to slate gray. It eats grass, roots, nuts, buds, and farm vegetables, and carries its food in its cheek pouches. It uses its short hairless tail as an organ of touch while going backward.

The gopher digs with the large strong claws of its front feet, and with its overhanging front teeth. It has poor eyesight and is slow. It rarely comes out of its burrow in the day. But a person can tell where it digs underground because it leaves little mounds of earth along the way. Gophers become destructive when they dig up agricultural land, such as orchards. A 12-inch gopher can dig a tunnel 300 times its own length in one night. The four teeth of a pocket gopher grow about 46 inches a year.

Scientific Classification. The gopher belongs to the family *Geomyidae*. The most common kind is genus *Geomys*, species *bursarius*.

STANLEY P. YOUNG

See also **PRAIRIE DOG**; **RODENT**.

GOPHER STATE. See **MINNESOTA**.

GORDIAN, *GAWR dih un*, **KNOT** was a skillfully tied knot mentioned in Greek mythology. A Phrygian peasant named Gordius used it to tie the ox yoke to his cart.

Gordius became king of Phrygia because an oracle advised it. He then dedicated his cart and yoke to Zeus (Jupiter). A legend said that the man who could loosen the difficult knot would become ruler of all Asia. Many people tried without success. Finally, Alexander the Great cut the knot with his sword, and declared that he had fulfilled the prophecy. Gordius was the father of Midas, whose touch turned everything to gold. Researches in the late 1950's uncovered a tomb in Turkey believed to be that of King Gordius.

The expression *cutting the Gordian knot* means solving a difficult problem in an unexpected way. **PADRAIG COLUM**

See also **MIDAS**; **PHRYGIA**.

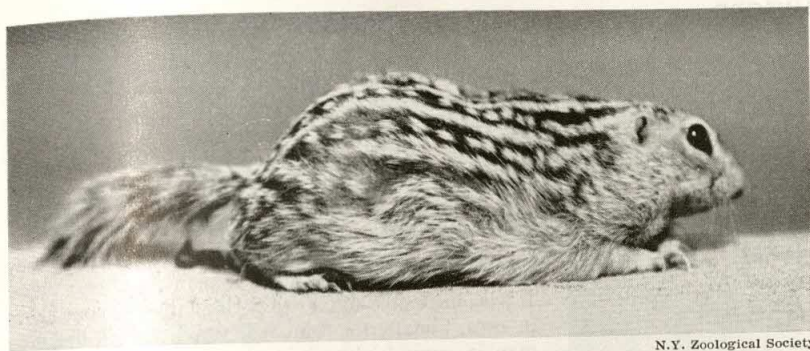
GORDIOIDEA, or **GORDIACEA**. See **ZOOLOGY** (Nematoda).

GORDON, CHARLES GEORGE (1833-1885), a British soldier, was called **CHINESE GORDON** and **GORDON PASHA** because of his distinguished service in China and Egypt. Gordon was born at Woolwich and educated at the Royal Military Academy. He fought in the Crimean War. He took part in the expedition to China in 1860, helped in the capture of Peking, and won remarkable victories as commander of the Chinese forces which suppressed the

Charles G. Gordon

Chicago Historical Society





The Striped Gopher, or prairie squirrel, has 13 stripes on its body. It lives mainly on the Western Plains of the United States.

N.Y. Zoological Society

The Common Pocket Gopher stores food in fur-lined pouches in the sides of its cheeks. Its long burrows often damage orchards.

Chicago Natural History Museum



Taiping rebels (see CHINA [Chinese Rebellions]).

In 1873, the viceroy, or *khedive*, of Egypt appointed Gordon governor of Southern Sudan. Gordon served as governor-general of the Sudan from 1877 to 1880, and spent the next four years in England. The British government then sent him to help the khedive withdraw troops from the Sudan. Gordon gallantly defended Khartoum, but was killed two days before the relief party under Lord Wolseley arrived (see WOLSELEY, GARNET JOSEPH). A devout Christian, Gordon won the respect of Chinese and Egyptians, and helped many poor English boys gain an education.

JAMES L. GODFREY

GORDON, CHARLES WILLIAM (1860-1937), a Canadian clergyman, became well known for his stories of Glengarry, Ont., and the Canadian Northwest. He

wrote under the pen name of RALPH CONNOR. His books were popular because they appealed to a sense of adventure and to the desire to serve mankind. His best-known novels were *Black Rock* (1898), *The Sky Pilot* (1899), *The Man from Glengarry* (1901), and *The Prospector* (1904). His autobiography, *Postscript to Adventure*, was published in 1938.

Gordon was born in Glengarry, Ont. He was or-

dained a Presbyterian minister in 1890. He then spent three years as a missionary among the miners and lumbermen of the Northwest Territories. His experiences there provided material for his novels.

DESMOND PACEY

GORDON, JOHN BROWN. See GEORGIA (Famous Georgians).

GORDON, JOHN CAMPBELL. See ABERDEEN AND TEMAIR, MARQUIS OF.

GORDON, RUTH (1896-), became one of America's first-ranking stage and motion-picture actresses. She won admiration in the theater for her versatility, technical skill, intelligence, warmth, and humor. Her acting triumphs include *Seventeen*, *Ethan Frome*, *The Three Sisters*, *The Country Wife*, and the motion picture *Abe Lincoln in Illinois*. She also wrote plays and articles. She was born in Wollaston, Mass.

CLIFFORD E. HAMAR

GORDON SETTER is a black and tan hunting dog that was well known as early as 1620. The Gordon setter was named for Alexander Gordon, a Scottish nobleman. The Gordon works slowly but carefully as a gun dog. It points with its nose to locate game for the hunter.

The Gordon is a medium-sized dog. It stands 23 to 27 inches high and weighs from 45 to 75 pounds. It has a long, flat coat, with a slight wave. The Gordon has long hairs on its ears, legs, and tail.

WILLIAM F. BROWN

See also DOG (color picture, Sporting Dogs).

GORE, ALBERT A. See TENNESSEE (Famous Tennesseans).

GORGAS, JOSIAH. See ALABAMA (Famous Alabamians).

Charles W. Gordon

Brown Bros.



GORGAS, WILLIAM CRAWFORD

GORGAS, GAWR *gus*, **WILLIAM CRAWFORD** (1854-1920), an American physician, became known as the world's leading sanitary expert. He helped make possible the construction of the Panama Canal by destroying the yellow-fever and malaria mosquitoes and the rats that carried bubonic plague.

He was born at Toulminville, Ala., near Mobile. Gorgas was graduated from Bellevue Hospital Medical College. In 1880, he was appointed first lieutenant in the medical department of the army. He became sanitary officer in Havana in 1898. He was promoted to the rank of colonel for wiping out yellow fever in Havana.

In 1904, Gorgas was appointed chief sanitary officer of the Panama Canal Commission, and he undertook the task of destroying yellow fever and malaria in the Canal Zone. A commission headed by Walter Reed had proved that a mosquito carried yellow fever (see REED, WALTER; YELLOW FEVER). Gorgas ordered the mosquito-breeding area cleaned up. Gorgas' contribution to the canal was as important, in its way, as that of George Goethals, the engineer who directed the completion of the project (see GOETHALS, GEORGE WASHINGTON; PANAMA CANAL [Victory Over Disease]).

Gorgas went to South Africa in 1913 to investigate the high death rate from pneumonia among diamond miners. In 1914, he was appointed Surgeon General of the U.S. Army with the rank of brigadier general. He was later appointed to the rank of major general. He headed the army's medical department for more than four years. In 1915, Gorgas published the book *Sanitation in Panama*.

GORGE. See CANYON.

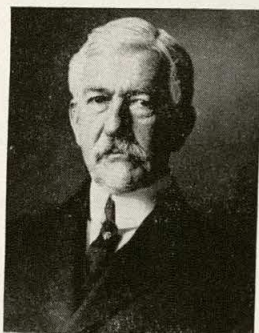
GORGES, SIR FERDINANDO. See MAINE (Exploration and Settlement).

GORGON, GAWR *gun*, in Greek mythology, was the name of three frightful beings, the daughters of the sea-god Phorcus. They had snakes on their heads instead of hair, and everyone who looked at their terrible faces was turned to stone. The two older ones, Stheno and Euryale, were immortal. The youngest sister, Medusa, was killed by Perseus. The winged horse Pegasus was born from her (see MEDUSA; PEGASUS). Perseus cut off Medusa's head and used it to turn his enemies to stone (see PERSEUS). The word Gorgon means *grim*, and is used to describe anything hideous.

H. LLOYD STOW

GORHAM, NATHANIEL (1738-1796), was a signer of the United States Constitution. He served in the Massachusetts legislature from 1771 to 1775, and as a member of the Massachusetts Board of War from 1778 to 1781. He served several terms in the Continental Congress, and was acting president in 1786 and 1787. In the Constitutional Convention, Gorham became president of the Committee of the Whole for several weeks and urged a strong central government. He was born in Charlestown, Mass.

ROBERT J. TAYLOR



Brown Bros.

William Crawford Gorgas

GORILLA, *go RILL uh*, is the largest of the *anthropoid*, or manlike, apes. It is the ape that looks most like a man. It is also the rarest. The gorilla lives in the forests of central Africa.

A male gorilla is usually more heavily built than a man, and nearly 6 feet tall when it stands upright. It can spread its great arms about 8 feet. A coat of coarse matted, brownish hair covers the animal. It becomes gray with age.

A gorilla is just as strong as it is huge. It could easily tear a man limb from limb. The male looks very fierce. It has long teeth, and a heavy ridge that juts out above its eyes. Usually the animal is timid. It will flee from man in great fright whenever it can. But once it is wounded or cornered, it will fight fiercely, tearing at its enemy with teeth and hands.

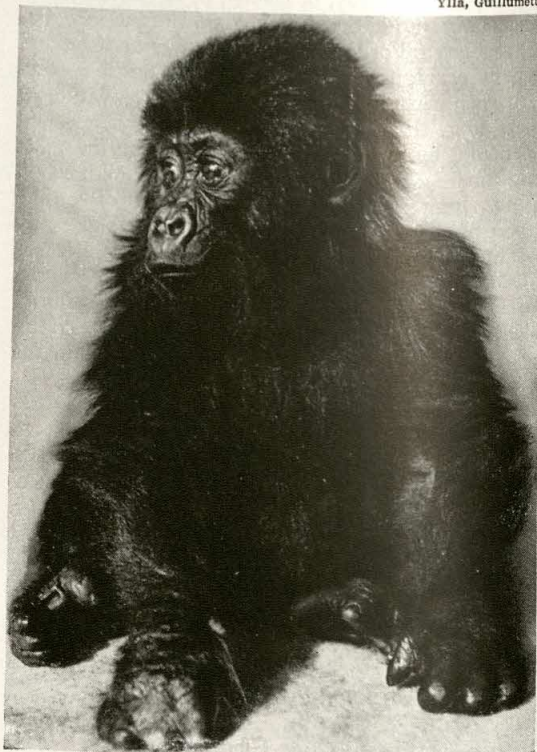
The gorilla usually walks on all fours. Sometimes it rises upright like a man, and walks more easily in that position than other apes do. Gorillas do not dwell in trees, but spend much of their time on the ground. They eat fruit, nuts, honey, and eggs, and do not kill other animals for their flesh. But they will eat meat if they can get it.

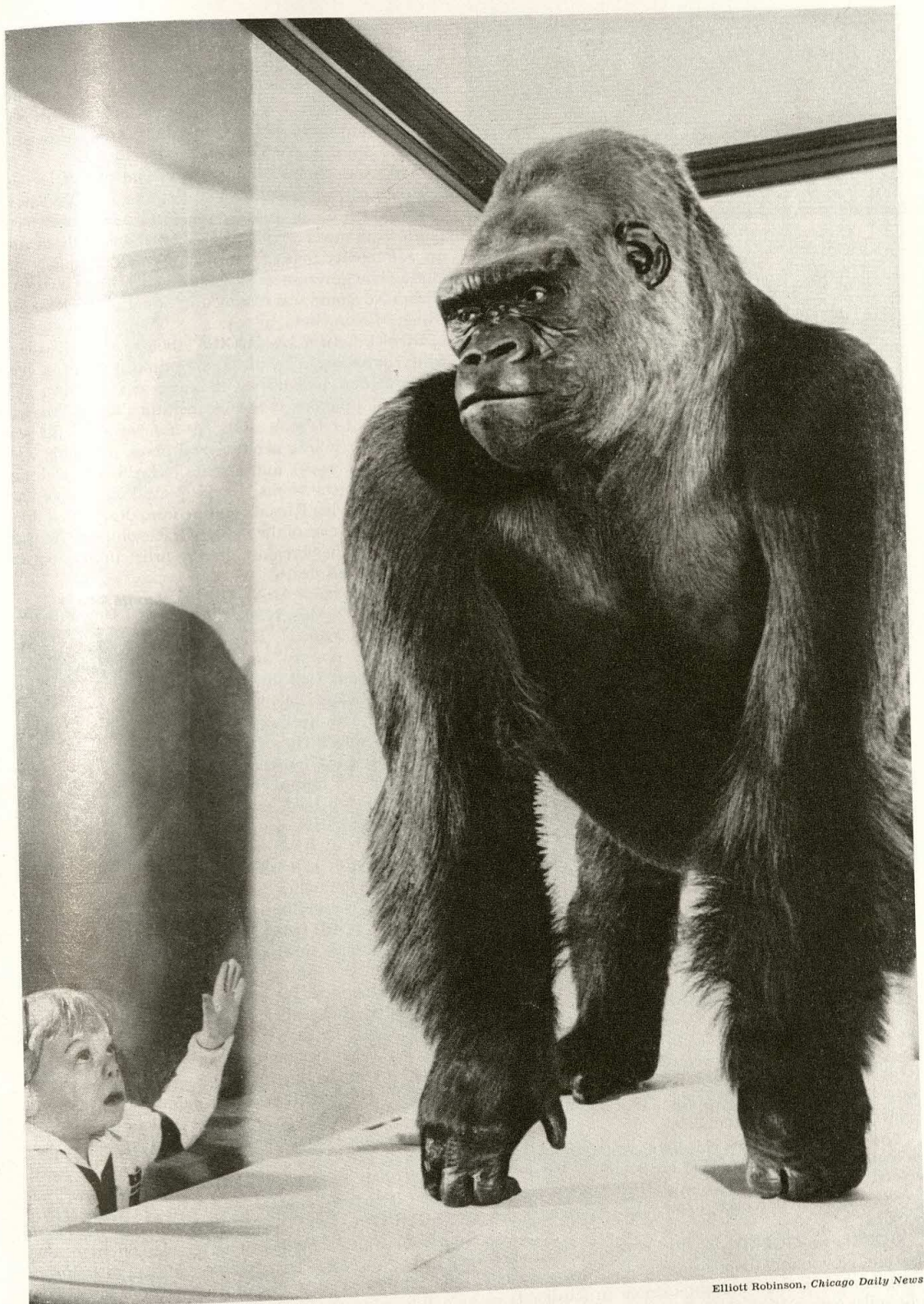
This great beast has few enemies. Most forest animals are frightened by the gorilla's loud, hoarse roars. Some gorillas have been known to live for more than 30 years. But scientists believe that an age of 22 for a gorilla is comparable to an age of 70 for a man.

Gorillas are quite scarce. As a result, Belgium set aside a 250 square-mile area in the Belgian Congo

A Gorilla becomes a huge animal with short legs and long, powerful arms when it matures. The tips of its fingers reach below its knees when it stands erect. In the daytime gorillas roam the forest for food. Gorillas spend most of the time on the ground.

Ylla, Guillumette

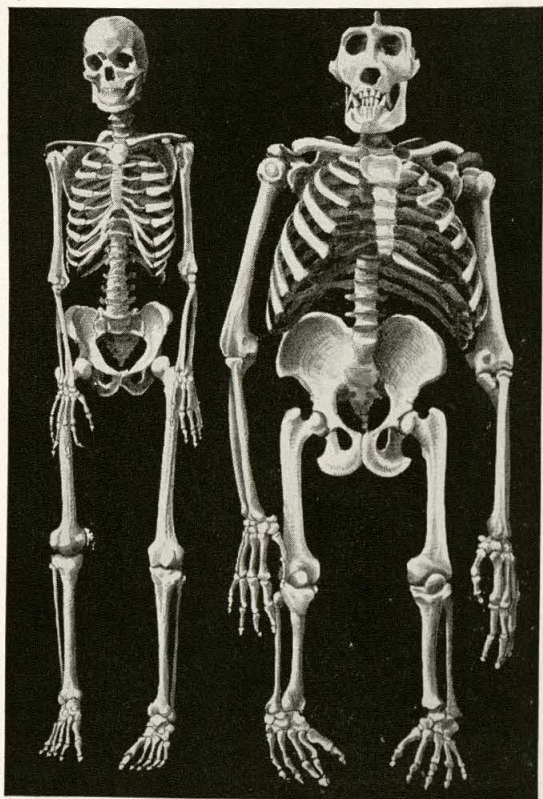




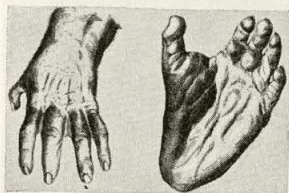
Elliott Robinson, *Chicago Daily News*

The Most Famous of All Gorillas was the huge Bushman of Chicago's Lincoln Park Zoo. Bushman weighed 550 pounds, and

reached a height of 6 feet 2 inches. He died in 1951. His body is now on display at the Chicago Natural History Museum.



Skeletons of Man (left) and of Gorilla



Hand and Foot of Gorilla

(now Congo), where gorillas cannot be hunted. Scientists can go into the sanctuary to study the way gorillas live. Several gorillas have been captured and sent to Europe and America. But because so little is known about

the animal in his natural surroundings, it has been difficult to keep them alive in captivity. However, in 1957 a baby gorilla was born in the Columbus (Ohio) Municipal Zoo, the first ever born in captivity.

The name *gorilla* was used by ancient peoples, but they had little knowledge of these animals. Present real knowledge of them goes back to about 1850. It was once thought that gorillas were a species of chimpanzee. This is not so, but the two apes are close relatives. It is the chimpanzee, not the gorilla, that can be trained to act almost like a human being.

Scientific Classification. Gorillas belong to the anthropoid ape family, *Pongidae*. They are genus *Gorilla*, species *gorilla*.

W. M. MANN

See also ANIMAL (color picture, Africa); APE; CHIMPANZEE.

GORKI, or **GORKIY**, *GAWR kih*, formerly called NIZHNI NOVGOROD (pop. 942,000; met. area, 1,250,000), is an important industrial center in Russia. It is 265 miles east of Moscow, at the fork of the Volga and Oka Rivers. For location, see RUSSIA (color map). Gorki is one of the oldest cities in the country and is known as

the *Cradle of the Russian Empire*. The upper part of the city contains a fortress and historic cathedrals. The lower town, built along the river banks, is the industrial section. One of the largest automobile factories in Russia is located here. Other manufactures include locomotives, airplanes, machine tools, and chemicals. Gorki is also a major transportation center.

Gorki was an important commercial center in the Middle Ages, when west-east travel along the Oka River and through a low pass in the Ural Mountains met north-south travel on the Volga River. One of the greatest commodity fairs of Europe was held annually at Gorki. The government discontinued this fair in 1930. Nizhni Novgorod was renamed in honor of the Russian writer, Maxim Gorki, in 1932.

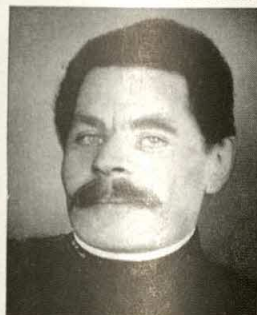
THEODORE SHABAD

GORKI, *GAWR kih*, **MAXIM** (1868-1936), a Russian writer, preached a heroic and optimistic view of life that was new to Russian literature at that time. He published a number of novels, including *Foma Gordeyev* (1899), *Mother* (1907), and *The Life of Klim Samgin* (1927-1936). He also wrote several plays, including *The Lower Depths* (1902), and a series of brilliantly realistic autobiographical works. Gorki played an important part in preserving Russia's culture from destruction during the early years of the Bolshevik Revolution. He was regarded as the foremost literary artist in the Soviet Union until his death.

Gorki was born A. M. Peshkov at Nizhni Novgorod (now Gorki). He grew up in poverty and harshness, and had little schooling before he was sent out to earn his living. He later wandered over southern Russia, often leading the life of a tramp. His experiences provided material for his first short stories, such as "Makar Chudra" and "Chelkash." He gained fame when his first stories were published in 1898.

Maxim Gorki

Brown Bros.



ERNEST J. SIMMONS

GORRIE, JOHN (1803-1855), an American physician, invented the first machine for mechanical refrigeration patented in the United States. He spent most of his life practicing medicine in Apalachicola, Fla. There, he investigated the artificial cooling of sick rooms and hospitals, hoping that it would reduce the ravages of fever. In 1851, he patented an ice-making machine which was similar in principle to later successful machines. But he lacked funds to manufacture it. Gorrie was born in Charleston, S.C. He represents Florida in Statuary Hall, Washington, D.C.

ROBERT P. MULTHAUF

GORSE. See FURZE.

GORTON, SAMUEL. See RHODE ISLAND (Famous Rhode Islanders).

GOSHAWK, *GAHS hawk*, is the name of the largest hawk in North America. The females often measure 25 inches in length. Their wingspread is 44 to 47 inches. Like all hawks, goshawks are fairly slender birds. They are known for their powerful flight. They flap their wings three or four times in flight, and then glide or sail for a few moments before they flap their wings again. They eat other birds and fly low through woods



Chicago Natural History Museum

The Goshawk hovers in the air, then plunges straight down with its long, sharp claws extended to seize its prey.

or over fields, catching their prey in the air. They are harmful to agriculture and are sometimes called *chicken hawks*, or *hen hawks*, because they eat useful birds and poultry. They are sometimes used for falconry. A number of other birds, especially in the tropics, are misnamed "goshawk."

Scientific Classification. Goshawks belong to the family *Falconidae*. They are classified as genus *Astur*, species *atricapillus*.

OLIN SEWALL PETTINGILL, JR.

See also **HAWK**.

GOSHEN, *GO shen*, was the section of northeastern Egypt that the pharaoh assigned to Joseph's brothers (Gen. 47). The Israelites continued to live in Goshen for 400 years, and eventually became Egyptian slaves. Goshen was a fertile triangle of less than a hundred square miles. A large canal bordered by several cities ran across it from the Nile River to the Bitter Lakes. The Book of Joshua mentions two places in southern Judah that were also called Goshen.

W. W. SLOAN

GOSHEN COLLEGE is a coeducational liberal arts school at Goshen, Ind. It is controlled by the Mennonite Church but admits students of all faiths. Goshen places emphasis on teacher training and advanced Bible study. The college was founded in 1894. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GOSNOLD, *GAHZ nohld*, **BARTHOLOMEW** (? - 1607), was an English navigator. In 1602, he explored the coast of New England from Maine to Buzzard's Bay. On this voyage he discovered Martha's Vineyard (see **MARTHA'S VINEYARD**). In 1606, Gosnold helped secure grants of American charters for the London and Plymouth companies. He belonged to the first governing council of the English colony, established at Jamestown, Va., in 1607.

JAMES G. ALLEN

GOSPELS are the first four books of the New Testament. They are named for the four men who are said to have written them: Matthew, Mark, Luke, and John. The first three books, the Gospels of Matthew, Mark, and Luke, deal mainly with the life of Jesus in Galilee.

None of the Gospels gives a complete story of the life of Jesus. Each is a collection of His acts and words, and is intended to be used for teaching. All four of the Gospel writers describe how Jesus was betrayed, arrested, and crucified, and how He arose from the dead. This story of Christ's sufferings is known as the *Passion Narrative*. It was probably the first account of events in the life of Jesus to be set down in writing.

The Gospel of Matthew shows Jesus as the Messiah of the Jews, who brought them the final interpretation of the law, and inaugurated the kingdom of God. The Old Testament had prophesied that this Messiah would come. Matthew understands the kingdom of God to be the church. He brings out the fact that the kingdom of God was meant to include not only Jews, but all nations. The Sermon on the Mount is in Matthew 5 to 7. The book ends with the command of the risen Jesus to the apostles: "Go ye therefore, and teach all nations."

The Gospel of Mark is the shortest of the four accounts. Saint Mark wrote it for Christians in Rome. His main subject is the power of Jesus to save, as shown by His miracles. Mark tells more about what Jesus did than about what He taught. He pictures Him as the divine Messiah and the Son of God. Mark repeated in his Gospel much of the preaching of Saint Peter. This is believed to be the earliest of the Gospels.

The Gospel of Luke was written for both Jews and Gentiles. Saint Luke shows Jesus as the Savior of the fallen, the outcast, and the poor. Luke says he based his book on stories told by "eyewitnesses and ministers of the Word." He means he was recording the testimony of the apostles and other early Christian preachers.

The Gospel of John describes the work of Jesus mainly in Judea. It tells much about the preaching of Jesus in Jerusalem. It stresses that from early in His ministry, Jesus publicly claimed that He was the Son of God. According to John, Christ existed before the world was created. He is the Word of God in human form. John tells the story of His acts and teachings in order to show how He revealed Himself to the world as the incarnate word or Son of God.

FREDERICK C. GRANT

See also **LORD'S PRAYER**.

GOSSAMER is a thin, filmy substance. It consists of fine, soft cobwebs and can be seen floating in the air on calm autumn days. Small spiders weave gossamer webs on trees or bushes. Slight drafts tear them from their fastenings and they float in the air.

GÖTA CANAL. See **SWEDEN** (Transportation).

GOTAMA BUDDHA. See **BUDDHA**.

GÖTEBORG, *YUH teh BAWR y'*, or **GOTHENBURG**, *GATH en burg* (pop. 380,442), is Sweden's second largest city. Göteborg lies on the Kattegat. For location, see **SWEDEN** (color map). The Göta Canal connects it with Stockholm, 150 miles northeast. Göteborg is the chief port on the southwestern coast. Its harbor is seldom blocked by ice. It is the largest shipbuilding center in Scandinavia.

JAMES J. ROBBINS



Bettmann Archive

The Gothic Tribes once lived near the Baltic Sea. They moved southward to the coast of the Black Sea, near the Danube River. Then they struck south and west into the Roman Empire.

GOTH was a member of one of the most powerful early Germanic tribes. In the 300's B.C., the Goths lived along the shores of the Baltic Sea. Beginning about A.D. 214, they attacked the declining Roman Empire. The Roman emperor Aurelian, about A.D. 272, moved Roman settlers out of Dacia (now Romania) and let the Goths take over. Within about a hundred years, the Goths split up into two groups. The *Visigoths*, or *West Goths*, occupied Dacia, and the *Ostrogoths*, or *East Goths*, lived north of the Black Sea.

The Visigoths. Beginning in 395, a Visigothic chieftain, Alaric, rampaged through Greece and then Italy. He captured Rome in 410. His successors established a kingdom in southern Gaul and Spain. The realm in Spain lasted until 711, when Roderick, the last king of the Visigoths, was killed during a battle with the Moors.

The Ostrogoths. When Huns from central Asia attacked the Ostrogoths about A.D. 370, many Visigoths, terrified, sought refuge across the Danube River in the Roman province of *Pannonia*. Many Ostrogoths followed them. They soon quarreled with the Romans. In the battle of Adrianople, in 378, the Gothic cavalry completely routed the Roman Army. In the late 400's, the young chieftain Theodoric united the Ostrogoths who had settled on the upper Danube River. With the approval of the Byzantine emperor Zeno, Theodoric invaded Italy, where he set up a model kingdom. After his death, Byzantine armies destroyed it, and the Ostrogoths disappeared as a people.

WILLIAM C. BARK

See also **ALARIC**; **CLOVIS I**; **SWEDEN (Early Years)**; **THEODORIC**; **VALENS**.

GOTHAM. See **NEW YORK CITY**.

GOTHENBURG. See **GÖTEBORG**.



Zentralbibliothek Zurich, Switzerland

A Page from a Gothic Manuscript, The Apocalypse of St. John, above, is a fine example of block printing from the 1400's.

Gothic Art

Gothic Painting. The emphasis on sharp, hard lines in Gothic painting can be seen in Antonio Pisanello's *Profile Portrait of a Lady*.

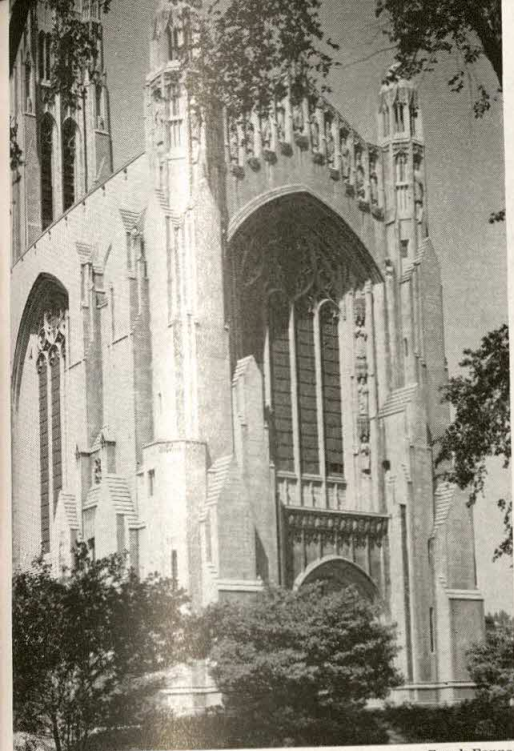


National Gallery of Art, Washington, D.C., Mellon Collection

GOTHIC ART is a term generally used for the art of Western Europe from the early 1200's through the 1400's. During the Renaissance, Italians thought that classical art, which they admired and sought to revive, had been corrupted during the Middle Ages by the *Goths*, Germanic tribes that had invaded Italy during the 400's. So they called medieval art *Gothic*.

Gothic Architecture was first created in France during the mid-1100's. The first Gothic buildings were parts of the abbey church of St. Denis and the cathedral of Sens. In the 1200's, Gothic architecture spread to England, Germany, Italy, and other parts of Europe.

Gothic architecture tended to emphasize height. Builders used pointed arches and tall, slender columns that rose from the floor to the stone framework of ribbed *vaulting* (see **VAULT**). *Flying buttresses*, or stone supports built against the outside walls, helped support the vaulting. Gothic builders also reduced wall surfaces, replac-



Frank Fenner

Examples of Gothic Architecture. The Cathedral of Notre Dame in Amiens, France, right, was begun in 1220 and completed in the early 1500's. Statues of 22 kings of Judah can be seen across the facade, directly beneath the rose window. Rockefeller Memorial Chapel at the University of Chicago, above, is a recent version of Gothic architecture in America. Its bell tower rises 207 feet above the campus.



Art Institute of Chicago

ing them with beautiful stained-glass windows that told religious stories (see STAINED GLASS). Gothic architecture originally had simple lines, but it became increasingly ornate. Its last phase is called *flamboyant*, from *flambe*, the Old French word for *flame*. The word refers to the flamelike curves of the decorative parts of the masonry, especially the *tracery* (see TRACERY).

Famous Gothic churches include the French cathedrals of Amiens, Chartres, Reims, and Notre Dame in Paris; Westminster Abbey and Canterbury Cathedral in England; and Cologne Cathedral in Germany.

Other Forms of Gothic Art often originated as part of decorations for Gothic cathedrals, but became independent. Craftsmen carved in stone, chiefly on church exteriors. They created religious figures as well as weird gargoyles (see GARGOYLE). Painters of the period illustrated Gothic books and manuscripts, including the famous Books of Hours (prayerbooks) first produced in

France (see MANUSCRIPT). Builders made simple, sturdy pieces of furniture, and often decorated them with carvings. They also used iron for many decorative purposes, such as church choir screens. Metal workers produced beautiful chalices and other objects, using filigree, precious stones, and enamels. Craftsmen carved ivory for church shrines and other objects. Tapestries hung on the walls of cathedrals and of some private homes (see TAPESTRY).

OTTO G. VON SIMSON

See also ARCHITECTURE (Gothic; picture, Middle Ages); CATHEDRAL; FURNITURE (The Middle Ages); PAINTING (The Middle Ages); SCULPTURE (Gothic Period).

GOTLAND. See SWEDEN (Location).

GÖTTERDÄMMERUNG, DIE. See OPERA (Some of the Famous Operas).

GOTTFRIED VON STRASSBURG. See GERMAN LITERATURE (Epic Poetry).



A Gouache Painting, by the brothers Pol, Jean, and Armand de Limbourg, shows a farmyard scene in February, 1415. The picture is from the famous *Book of Hours* for the Duke of Berry.

GOUACHE, *gwahsh*, is a method of painting that uses *opaque*, or nontransparent, water colors. Gouache is less coarse and more sensitive than other opaque water paints. In gouache, the artist uses white pigment to produce whites and pale tints. This technique differs from that used with transparent water color, in which the artist allows the paper to show through to create whites and pale tints. The ingredients of gouache and water colors are similar, but they are compounded differently. Gouache can be handled in a smooth, precise manner, but the typical gouache painting has free brushwork with some variety of texture. It usually has a bright, sparkling color. See also **PAINTING** (color picture, *June* from *The Duke of Berry's Book of Hours*); **WATER COLOR**.

RALPH MAYER

GOUCHER COLLEGE is a privately controlled liberal arts college for women at Towson, Md. Founded in Baltimore in 1885, the school moved by stages to Towson between 1941 and 1954. Goucher offers A.B. and M.Ed. degrees. It admits a few exceptional students who have not completed high school. For enrollment, see **UNIVERSITIES AND COLLEGES** (table). MILDRED COVEY

GOUDY, FREDERIC WILLIAM (1865-1947), was an American type designer and printer. Over a 50-year period, he made 122 designs for type faces. Among them are several that are commonly known, such as Goudy Old Style, Forum, and Kennerley. Goudy showed an early fascination for letters by drawing 3,000 of them and cutting them out of colored paper to form the Ten Commandments. In 1920, he received the gold medal of the American Institute of Graphic Arts. Goudy was born in Bloomington, Ill. RAY NASH

GOUJON, GOO Z'HAHN, JEAN (1510?-1568?), became one of the greatest French sculptors of the Renaissance. He was also an architect. Through his contact with Italian sculptors brought to the French

court by King Francis I, Goujon popularized the Italian Renaissance in France. He worked on the Louvre, where some of his sculptures and a marble chimney may still be seen in place. His most famous and pleasing sculpture is the *Fountain of the Innocents* in Paris. He was born in Normandy.

MARVIN C. ROSS

GOULASH. See **HUNGARY** (Way of Life).

GOULD, *gold*, is the name of a prominent American family of financiers associated with railroads.

Jay Gould (1836-1892) founded the family fortune.

In 1860, he began his railroad career by buying control of the Rutland & Washington Railroad. He later sold it at a profit. He repeated this process of buying and selling with other small railroads. In 1867, he and James Fisk joined Daniel Drew on the board of directors of the Erie Railroad. Through the irregular issue of stock, they kept Cornelius Vanderbilt from getting control of the line. Gould made millions by manipulating Erie stock. In 1869, he and Fisk tried to corner the gold market. Their operations caused the "Black Friday" panic of September 24, and Gould became "the most hated man in America" (see **BLACK FRIDAY**).

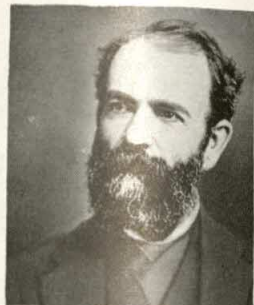
In 1872, Gould was forced out of control of the Erie. A lawsuit against him was withdrawn when he returned several million dollars to the company. He then turned to western railroads. Among those he came to own or control were the Union Pacific, Kansas Pacific, Denver Pacific, Missouri Pacific, Central Pacific, Texas & Pacific, St. Louis Southwestern, and Wabash. Gould was said to own about one of every 10 miles of railroad in the United States by 1880. In 1881, he gained control of the Western Union Telegraph Company and later of the New York elevated railroad. At his death, his fortune was estimated at \$72,000,000. He was born in Roxbury, N.Y.

George Jay Gould (1864-1923) was Jay Gould's oldest son. He took over his father's railroads and expanded them. He later lost control of the Gould lines.

Helen Miller Gould (1868-1938) was Jay Gould's oldest daughter. She spent most of her life in philanthropic activities, making large contributions to charities and to educational institutions. She gave New York University a library and the Hall of Fame (see **HALL OF FAME**). In 1913, she married Finley J. Shepard (1867-1942), a railroad official. KENNETH W. PORTER

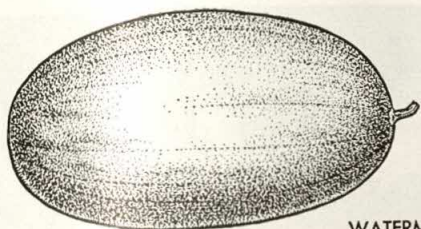
GOULD, CHESTER. See **COMICS** (Dick Tracy).

GOULD, MORTON (1913-), a composer, conductor, and arranger, became known for his clever use of American folk and popular music. His orchestral works include *Chorale and Fugue in Jazz*, *Stephen Foster Gallery*, *Swing Symphonietta*, *Spirituals*, and *Concerto for Tap Dancer and Orchestra*. Gould was born in Richmond Hill, N.Y. As a small child, he began to compose and to play the piano in public. He was graduated from New York University at 15. He conducted at the Radio City Music Hall and for radio. GILBERT CHASE

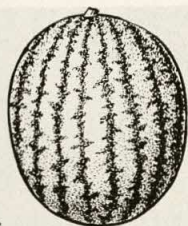


Brown Bros.

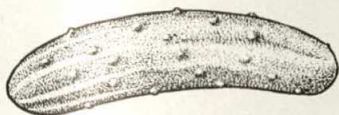
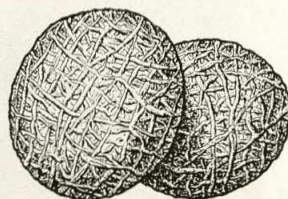
Jay Gould



WATERMELONS



MUSKMELONS



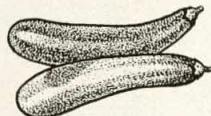
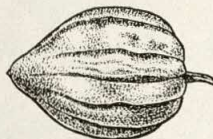
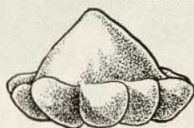
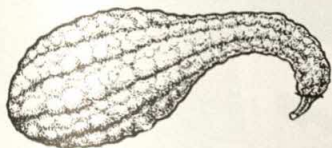
CUCUMBER

MEMBERS of the GOURD FAMILY

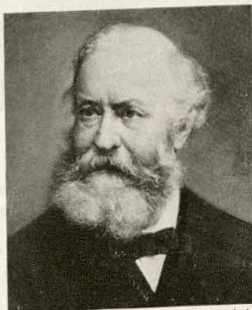


PUMPKIN

SQUASHES



GOUNOD, GOO NOH, CHARLES FRANÇOIS (1818-1893), was a French composer. His fame is based on the continued popularity of his opera, *Faust* (1859), and on his well-known "Ave Maria" (1859). He added this melody to the first prelude in Johann Sebastian Bach's *The Well-Tempered Clavier*. Among Gounod's other operas, two deserve mention. They are *La Reine de Saba* (The Queen of Sheba, 1862) and *Romeo et Juliette* (1867). Other compositions include choral works and music for orchestra, piano, and chamber groups.



Chicago Historical Society

Charles François Gounod

Gounod was born in Paris. He received a degree in classical studies from the Lycée St. Louis, and then entered the Paris Conservatory. Later, he studied in Rome, where he developed his interest in church music. After his return to Paris, he entered a religious seminary, but soon recognized this change in career as a mistake. His first opera was performed in 1851. From 1852 to 1860, Gounod conducted a Parisian choral society. After 1860, the stage claimed an increasing share of his attention.

THEODORE M. FINNEY

GOURD, gohrd, is the name of a group of ornamental trailing or climbing plants. Gourds are vegetables closely related to squashes and pumpkins. They grow wild in America, Africa, and the Pacific Islands. Gourds bear fruits of various colors and shapes. The leaves are large with pointed lobes. The flowers are usually yellow.

Some of the smaller and more attractive gourds include the *salt-and-pepper gourds*, the *nest-egg gourds*, and the *dishcloth gourds*. This gourd, also called a *luffa*, has become popular in America. The inside of the dried

fruit is full of fibers that make a dishcloth or bath sponge which smells sweet and clean. Very young dishcloth gourds are among the few that can be eaten.

Bottle gourds bear large fruits that are raised mainly as novelties and ornaments. In Africa and Asia, the bottle-shaped fruits are dried and used to hold water and other liquids. Other popular kinds of gourds include the *dipper*, *pipe gourd* or *calabash*, *apple*, *orange*, and *pear-shaped gourds*, *powder horn*, and *Hercules'-club*.

Gourds grow easily. The seeds need only be planted in a sunny location after danger of frost has passed.

Scientific Classification. Gourds make up the family *Cucurbitaceae*. Bottle gourds make up the genus *Lagenaria*. The dishcloth gourd found in North America is genus *Luffa*, species *cylindrica*.

ARTHUR J. PRATT

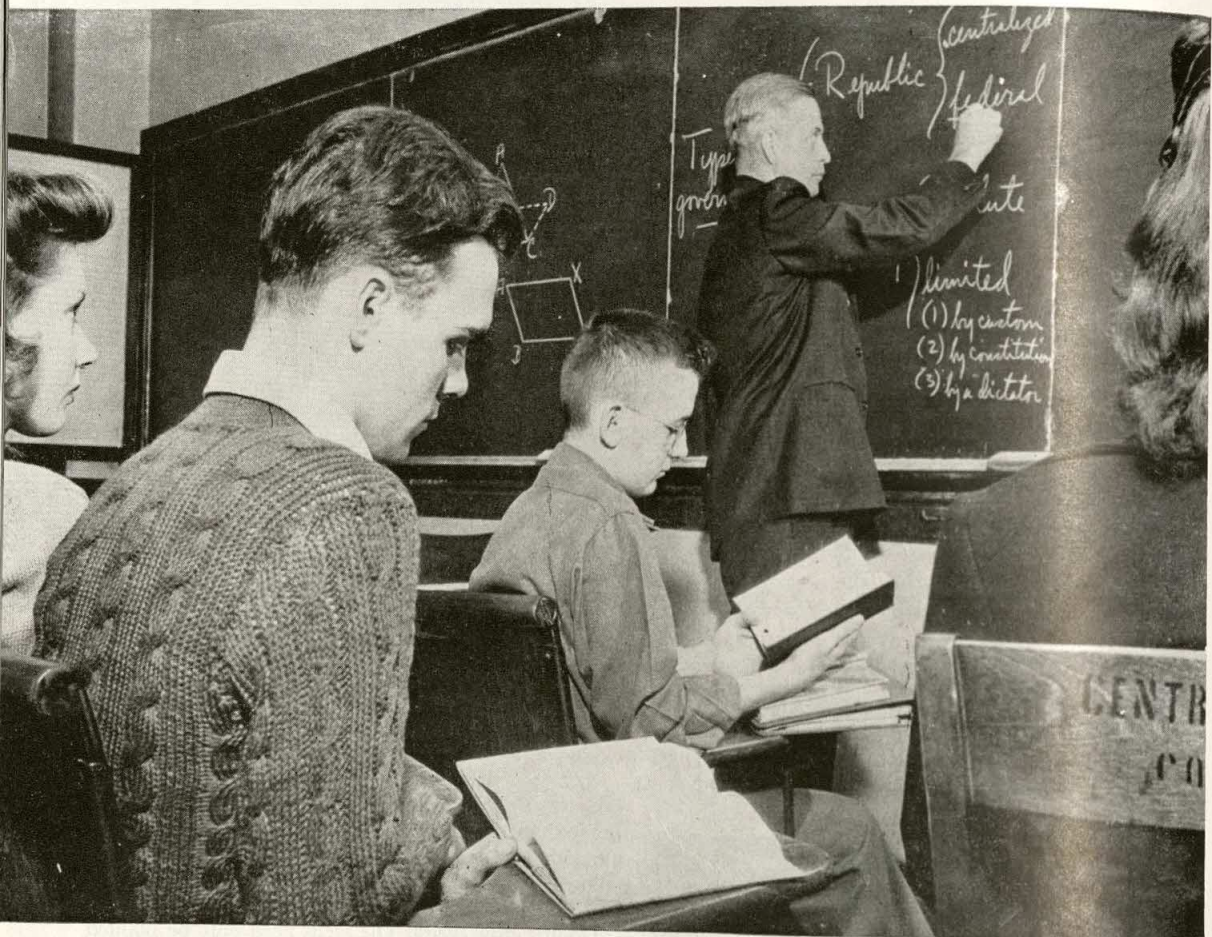
Related Articles in WORLD BOOK include:

Calabash	Cucumber	Muskmelon	Squash
Casaba	Luffa	Pumpkin	Watermelon
Chayote	Melon		

GOURDE, goord, has been the standard monetary unit of the Republic of Haiti since 1920. It is issued in silver coins and paper notes. *Gourde* is the old French name for the Spanish dollar. For the value of the gourde, see **MONEY** (table, Values of Monetary Units).

GOUT, gowt, is a chronic disease that produces severe swelling of the joints. It is caused by a defect in the body's natural action of breaking down certain proteins. This results in the production of too much uric acid, which accumulates in the blood (see **URINE**). Crystals of uric acid are deposited in tissues around the joints. These deposits cause sudden attacks of swelling, most commonly in the feet. This is called *gouty arthritis*. The tendency to gout is hereditary. Treatment consists of limiting the amount of protein in the diet, and of taking drugs such as aspirin and probenecid to hasten the elimination of uric acid. Colchicine is a drug which relieves acute gouty attacks. Gout is not curable, but is controlled by proper treatment.

JOSEPH LEE HOLLANDER



United Press Int.

GOVERNMENT. In a democratic country like the United States, government is the means the people use to provide justice for everybody, to defend the nation from attack, and to promote the welfare of the nation. A democratic government is a political organization for these purposes. The people take full part in it. In contrast, a dictatorship is a form of government under which the people are ruled. They have little real part in the process of governing.

Even the smallest community has to have laws or rules regulating traffic, public health, and public order. For instance, drivers must keep to the right on roads, streets, and highways in the United States. The rules of the road must be decisions of government for all persons to follow, enforced, if necessary, by government.

Citizens must combine in order to protect themselves against thieves and other criminals. In disputes, courts are needed to determine the rights of one citizen as opposed to those of another. Again, many projects such as building a bridge, repairing a public road, or running a fire engine require control by government. In large communities, or nations, a central government is needed to provide defense against foreign aggression. Inspection of foods and other products for sale also requires supervision by a central administration.

Lack of government would lead to confusion, chaos, or even anarchy. Such a situation sometimes comes after a great disaster has destroyed the existing government.

Everyone Is Free to Learn in a Democracy, and teachers are free to draw upon all the great store of human knowledge and opinion. If these students were living in a dictatorship, they could learn only what the ruler wanted them to know.

Efficient and progressive government is one of the chief goals of Western civilization. It can be achieved only if all the people take part in it. If the citizens are indifferent, careless in obeying the laws, too lazy to vote, and unwilling to serve as public officers, then government will decline. Good government requires eternal vigilance and personal sacrifice on the part of every citizen.

When we refer to "a government" or "the government" we usually mean government in connection with the idea of the *state*, or nation. In the United States, people commonly think of a state only as one of the states of the Union. But students of government call an entire country a state. In this sense, the state is a combination of people, territory, political organization or organized government, and sovereignty or independence. For instance, the American *people* occupy the *territory* covered by the United States. They have a definite *political organization* including the federal, state, and local governments, and they possess *independence* from all other countries.

"Of the People, by the People, for the People"

The most accurate short description of democratic

government is the phrase, "government of the people, by the people, for the people," used by Abraham Lincoln in his famous Gettysburg Address. The entire purpose and means of American politics are summed up in this historic phrase. It says that the government exists for the people, and not the people for the government. The will of the people prevails. The men and women who make and carry out the laws come from the people.

The American people are deeply inspired by ideals. They are, at the same time, immensely practical. The history of the United States shows that, while the American people hold competence and efficiency in high esteem, they have recognized that practical methods which have no idealism or morality bring little permanent advantage to the nation.

Self-government is one of the most precious of democratic ideals. The principle of self-government in America has almost always meant representative government—a system by which officers elected by the people make and execute the laws. See DEMOCRACY; UNITED STATES, GOVERNMENT OF.

The liberty of the individual has also been a cherished ideal of the American people. The first eight amendments to the United States Constitution preserve basic personal liberties. See BILL OF RIGHTS; FREEDOM; UNITED STATES CONSTITUTION (first eight amendments).

One of the democratic ideals that have long been accepted in both Great Britain and the United States is the equality of all men and women before the law.

In a government "of the people, by the people, for the people," a heavy responsibility rests on every citizen to take part in civic affairs to the best of his ability. Citizens who are indifferent soon take their country down the road to undemocratic practices and to tyranny. The responsibility of citizens goes beyond payment of taxes, obedience to law, and service in the armed forces of the nation. It includes willingness to inform themselves regarding the political and social issues of the day, and to join in public discussion of these questions. The good citizen will join a political party and seek to select good candidates for nomination by that party. Or, if he chooses to remain an independent, he will make known his opinions on candidates and issues. He will always vote in elections and also will urge his neighbors to vote. He will serve on local committees, and even accept nomination to political office if called upon for such duty by his fellow citizens. If he is elected to office, he will perform his service to the state as faithfully, justly, and wisely as he can.

When Tyrants Rule

Among the ancient Greeks, the dictator was known as the *tyrant*. His one-man rule was called a *tyranny*. He ruled by absolute and uncontrolled power. This form of government frequently occurred in the Greek city-states in times of public distress or national danger.

Many of the great empires of the East and West were tyrannies, or *despotisms*. The emperor, king, or potentate was *authoritarian* in character. This means that he took upon himself the right to rule; his authority was not a grant of powers from the people.

Dictatorships of our own times have much in common with the tyrannies of the ancient world. All tyranny is basically the same, whether it is called dictatorship, despotism, absolute monarchy, authoritarian-

ism, racial state, fascism, corporate state, nazism, bolshevism, sovietism, communism, or by any other name. In their disregard of the rights of citizens and their contempt for human life, there is little difference among Nero, Ivan the Terrible, Genghis Khan, Mussolini, Hitler, Lenin, Stalin, Perón, Tito, Mao Tse-tung, and Malenkov. All these dictators trampled on the liberties of the people, resorted to violence and torture, and seized the power to govern. They all used murder and treachery as means of grasping authority.

In the 1900's, the two principal forms of dictatorship have been fascism and communism. The two chief examples of fascism are Benito Mussolini's fascist Italy, in 1922-1944, and Adolf Hitler's nazi Germany in 1933-1945.

Both fascism in Italy and nazism in Germany destroyed human liberty. But of the two, the nazi dictatorship was the most cruel and destructive of human liberties. See FASCISM; HITLER, ADOLF; GERMANY (History); NAZISM.

Soviet communism was established in Russia by the Bolshevik Revolution of 1917. Soon after World War II, Moscow-directed revolutions led to the establishment of communist regimes in other countries of Europe and Asia. These states became subject nations, or *satellites*, of Russia, under communist control.

In the Soviet Union and its satellites, the communist rulers have assassinated political enemies and forced free men to become slave laborers. See COMMUNISM; STALIN, JOSEPH; RUSSIA.

Modern Ideas of Government

Background of Modern Thought. From ancient times, governments have been classified on the basis of the number of citizens who take part in the operation of government or in the election of officers. About 2,400 years ago, Aristotle made an elaborate grouping of constitutions according to (1) the number of people who have the power of choice in government, and (2) the end, or purpose, of government. The true purpose of a state, said Aristotle, is the perfection of its citizens. Accordingly, when government is directed toward the improvement of all its citizens it is pure government, but if the government aims at the perfection of fewer than all the citizens, it is a corrupt form of government. Aristotle believed that the pure form of one-man rule is monarchy, while the corrupt form is tyranny. The pure form of rule by the few is aristocracy (rule by the most intelligent), while the corrupt form is oligarchy (rule by the wealthy). The pure form of rule by all the people is *polity*, said Aristotle, while the corrupt form is uncontrolled democracy. Aristotle did not have the high regard for democracy that the Western World now extends to it. Aristotle's polity was a *mixed government*, in which (1) all the people shared the power to govern with (2) representatives of property and (3) representatives of the ablest citizens. Aristotle understood human nature well enough to realize that any particular form of government might not be the best government for all peoples at all times. Some peoples might be governed best by a form not suitable to other peoples. Ideally, however, Aristotle held that the best forms of government were in the following order of preference: (1) pure monarchy,

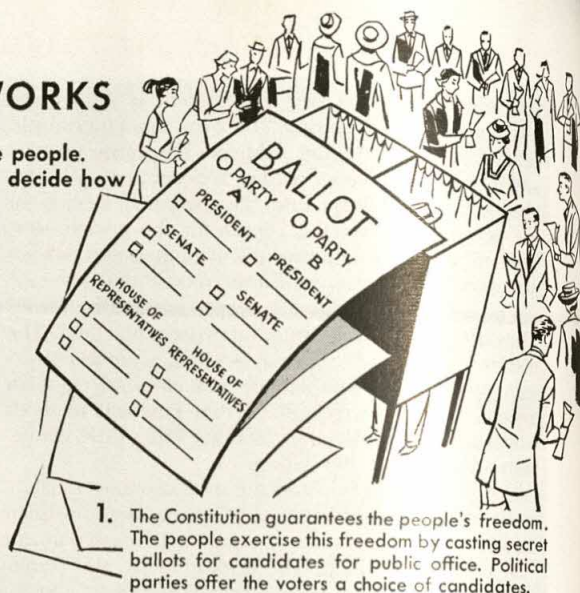
HOW DEMOCRACY WORKS

In a democracy, power stems from the people. "We the People" have the freedom to decide how and by whom we shall be governed.

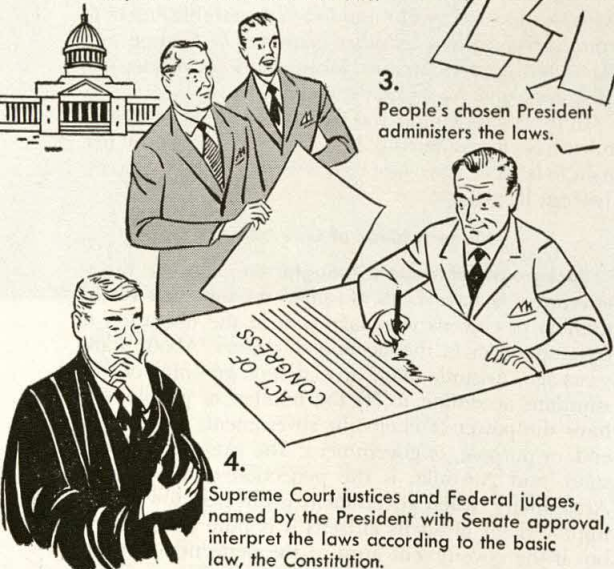
(2) pure aristocracy, (3) mixed aristocracy, and (4) polity. The worst forms of government were, in order of preference, tyranny, unrestrained oligarchy, and unrestrained democracy.

From Mixed Republic to Representative Democracy.

The pages of *The Federalist*, a collection of essays by James Madison, Alexander Hamilton, and John Jay in support of the American Constitution of 1787, show that the Fathers of the Constitution intended to found a mixed republic rather than a completely democratic form of government. Instead of setting up a one-chamber legislature, directly representing the people in the elec-



2. People's chosen Senators and Representatives make the laws.



Democracy does not mean that every citizen actively takes part in every decision of government. Meetings of all voters are impractical in a large country like France or the United States. Modern democracy on a national scale is representative democracy. Government is conducted by the representatives elected by the people. Representative democracy rests on the principle that power to govern rests with the people; while, for the sake of convenience, they have delegated their powers to their representatives. Representative democracy also assumes that every citizen of a certain age should join in the election of the representatives.

The belief that every man and woman is capable of valid judgment has led to the provision for universal suffrage, or the right to vote, in democratic countries. Democracies also feel that every individual has something to contribute to the group. The economic wealth of a nation, its security, and its public education are among the things that are greatly affected by the way its citizens use the ballot. See VOTING; WOMAN SUFFRAGE.

5. People can review and discuss the work of their elected officeholders, and freely vote for or against them at regular elections. The people can even remove a bad official before his term is up.



Dignity of Mankind. The supporters of dictatorship scoff at the democratic concept of the dignity of all mankind. Fascist and nazi writers insist that the *elite*, or persons of superior intellect, training, and oppor-

tion districts, the Constitution provided for a House of Representatives which should represent the people, and a Senate which should represent the different states. Instead of providing for direct election of the President, the Constitution called for his selection by presidential electors chosen in each state in such manner as the state legislature might direct. In other words, the Fathers of the Constitution established a representative form of government which was in reality a mixed republic. But, in the course of the first 150 years under this Constitution, the national government became largely a representative republic, or democracy. By constitutional amendment, Senators were elected directly by the people. Without a constitutional amendment and simply by custom or usage, the selection of the President follows the vote of the people. See ELECTORAL COLLEGE; PRESIDENT OF THE UNITED STATES; SENATE.

HOW DICTATORSHIP WORKS

In a dictatorship, power stems from the dictator. The people have no freedom to choose the officials and the policies of the government.

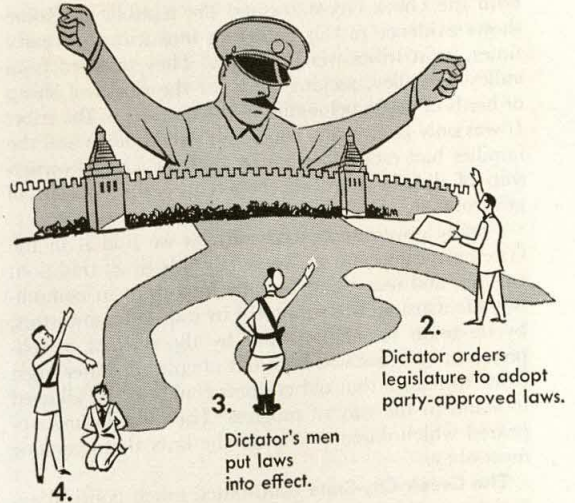


1. Dictator hand-picks candidates for office. People must vote for those he chooses, on a one-party ballot.

How Government Developed

Theories About Origin. There have been at least four general theories about the origin of government. They are: (1) divine origin; (2) single lawgiver; (3) social contract; and (4) historical evolution.

The theory that government is of *divine origin* has long since been discarded. The Romans' twelve tables of law, which they believed to have been divinely inspired, followed this theory. Belief in divine origin of government also frequently led to the assertion of the doctrine of "divine right of kings," on the theory that monarchs had been appointed by God.



3. Dictator's men put laws into effect.

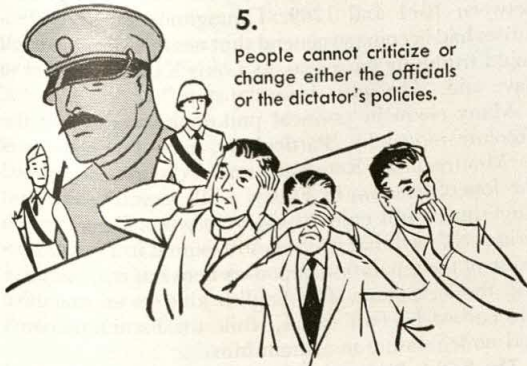
2. Dictator orders legislature to adopt party-approved laws.

4. Courts obey dictator rather than law. Men often lose life and liberty in mock trials.

tunity, should rule the state. Communist practice also follows the theory of the *elite*, even though Russian bolshevism pretends to show deep concern for the workingman.

Opposition Parties. The democratic system insists that opposition parties shall be permitted to exist, as part of the people's right to free speech and to participation in government. It holds that the monopoly of politics by one party, as found in all fascist and communist states, is a denial of the democratic ideal that every man should be free to speak his mind, and to vote against a government he does not like.

Misuse of Term "Democracy." Soviet propaganda recognizes that the word *democracy* is a powerful symbol. Therefore the communists distinguish between "bourgeois" democracy and "true" democracy. Bourgeois democracy, according to the communist line, is the rule of capitalist governments, and true democracy is government by the dictatorship of the *proletariat*, or common people. The communists say that the democracy of the Western World is harmful to the working class, but that



5. People cannot criticize or change either the officials or the dictator's policies.

communist democracy gives the workingman control of the state. Communist propaganda, however, fails to point out that the workingman in Russia actually has no real part in government except to obey orders.

The theory of the *single lawgiver* was often advanced in Greek civilization. For instance, the government of Sparta was credited to the magistrate Lycurgus; and the government of Athens to Solon. The evidence of history, however, shows that government came before even these ancient wise men lived.

The *social contract* theory goes back to Plato, 2,400 years ago. It flourished again in the 1500's and 1600's. According to this theory, men in a state of nature entered into a compact with themselves or with a king to surrender some of their natural rights and to submit themselves to a supreme government.

The chief fault with this explanation, as David Hume pointed out, is the fact that we have no historical evidence of any such contract. Indeed, the evidence seems to be contrary to the theory. The Mayflower Compact (1620) was not a contract of this nature, for the signers

GOVERNMENT

were already subjects of King James, and they brought the already existing laws of England with them to Massachusetts Bay.

The most reasonable explanation seems to be *historical evolution*, that government evolved out of the early organization of the family.

Beginnings of Government in the Family. The first unit of government in ancient times seems to have been the family. Even in the era of the cavemen, the group of father and mother and children appears to have been the natural social and even political organization. See **FAMILY**.

In early Greek and Roman history, kinship seems to have been the key to political unity. The father, or *patriarch*, ruled the family, consisting of mother, sons, and daughters, and also, as the family increased, of his grandsons and granddaughters. The authority of the father in early Rome soon came to be part of Roman law.

As families came into contact with one another, they joined together into tribes, either as a result of war or for mutual protection and assistance. The history of both the Greek city-states and the republic of Rome shows evidence of this gathering into tribes. In early times, most tribes were nomadic. They traveled from valley to valley, seeking grass for the flocks of sheep or herds of cattle belonging to the families in the tribe. It was only later, when tribes had settled down and the families had established farms, that the idea of ownership of definite territory entered into the concept of government.

Finally government took form as we find it in the Greek city-state and in Rome. By this time, tradition, custom, and usage had become important in community life. Custom was supported by respect for ancestors, by devotion to religion, and by the instinct of self-preservation. Law was born out of custom. Later, men came to realize that old customs could not be allowed to stand in the way of progress. Then legislatures appeared which dared to change the laws that everyone must obey.

The Greek City-State contributed much political experience and wisdom to mankind. As popular assemblies were established, all male citizens took part in government. Slaves were not citizens and so did not participate. Eventually, the Greek city-states experienced many forms of government, including both good and bad government of the one, the few, and the many. See **ATHENS**.

We must also mention the Greek Stoics. They gave the world the concept of the universal brotherhood of mankind, which Cicero later introduced into Roman thought.

Roman Government. Roman history made a contribution to the development of government as important as that of the Greeks. During the period of the free republic of Rome, every citizen had a right to take part in lawmaking. Citizens shared responsibility for government with groups that represented wealth and wide experience. Thus they had a "mixed government" of considerable merit. But, under Augustus Caesar and Tiberius, during the first 50 years after Christ's birth, the Roman people became accustomed to *Caesarism*, or one-man rule. Many of the forms of repub-

lican government remained, but the state was really ruled by the emperor alone, supported by a large bureaucracy.

Eventually, slavery was abolished in Roman territory. All people in the provinces received the privilege of Roman citizenship, and the great Roman law was *codified*, or written down in orderly form. The ideal of world peace, under the name of the *Pax Romana*, or *Roman peace*, prevailed for several centuries. But the Roman Empire was based on force, and it could not withstand the external pressure of the Visigoths, the Ostrogoths, and other barbarians. These barbarians raided and finally destroyed the empire, only to become devoted followers of Rome's greatest contribution to government—Roman law.

The National State. Roman law had made such a powerful impression upon the European mind that many men continued to think that peace and prosperity could be achieved only by means of a universal empire. This thinking bolstered the tottering fortunes of the Germanic Empire (called the Holy Roman Empire) in its contest with the church for the supremacy of Europe. The trend of history, however, opposed both the outmoded Holy Roman Empire and the papacy. The rise of the new national state was destined to destroy hopes of a revival of the Roman Empire. France, England, Spain, The Netherlands, Sweden, and Russia had appeared as states which demanded and secured complete national control over their own resources. Germany, under the Lutheran Reformation, joined the group headed toward the national state. At an early stage in the development of the national state, feudalism (the relation of lord to vassal and the binding of serfs to the land) declined and gave way to landowning peasantry. See **FEUDALISM**.

In England, the powers of the king were continually cut down by Parliament. In The Netherlands, the executive had limited authority. In Venice, an aristocracy governed the republic. But most of the new states became absolute monarchies, such as France, Spain, Prussia, Austria, and Russia. In these states, legislatures which might restrain the king and his ministers had disappeared. After 1580, the king of Spain largely ignored the *Cortes*, or legislature, of that country. In France, the *States-General*, or legislature, was not called between 1614 and 1789. Throughout Europe, absolutism had become so general that nearly every monarch could truthfully have said, as Louis XIV is reported to have said, "The state, I am the state."

Many eloquent political philosophers criticized the absolute monarchy. Particularly, such French writers as Montesquieu, Rousseau, and Voltaire condemned the loss of freedom in France while pointing out that Englishmen still enjoyed their liberties. These French writers claimed that freedom still existed in England because of the separation of powers between the executive and the legislature. The English king as an executive was curbed by Parliament, while the French monarch had no legislature to restrain him.

The British Parliament has been more widely copied by other states than any other modern national assembly. This Parliament can be traced back in history to the meetings of the Angle and Saxon chiefs and warriors in the Germanic forests. These peoples conquered England and brought their laws and customs into the



United Press Int.

Grim Game of "Follow the Leader" is the role of youth in a dictatorship. These young drummers are being trained in unthinking obedience to authority. In a democracy, boys and girls develop team play, initiative, and leadership.



Industrial Sports Journal, U. S. Rubber Co.

country. As the institution of kingship appeared in England, these gatherings became known as the King's council.

The Norman Conquest of England in A.D. 1066 brought more energetic government. The King's council included the king, the barons, and the higher clergy. The need to levy extensive taxes led the King to summon rich merchants and farmers to his council in Westminster to submit to taxation. These "commoners" sat in a lower chamber, which was later called the House of Commons. Eventually, the barons and clergy who had formerly sat in two chambers came to sit in one upper chamber called the House of Lords. By A.D. 1295, when the "Model Parliament" of Edward I met, the British legislature was well on the road to its modern form. See PARLIAMENT.

Parliament finally took full advantage of the meeting of the houses to demand settlement of grievances from the Crown before any grant of taxes was voted. From this practice developed the passage of bills which became law upon the assent of the King. This procedure was the beginning of the modern legislative process, and of the principle of "no taxation without representation."

In 600 years of struggle between Parliament and the Crown, the legislature won victory after victory in asserting the rights of citizens against the despotic power of the King. In the Magna Carta, A.D. 1215, King John promised the barons that he would not illegally arrest or oppress any of them. (See MAGNA CARTA.) Gradually, Parliament won the same rights for all Englishmen. The King frequently reasserted his old privileges, and the struggle was repeatedly renewed. A civil war was set off in 1642 by the defiance of Charles I, which resulted in defeat for the King on the battlefield, and his execution. The Bill of Rights, adopted by Parliament in 1689 with the assent of the King, became a model bill of rights that was copied by numerous countries.

In the struggle between Parliament and the King, the legislature was rapidly winning complete supremacy. In 1742, Robert Walpole asserted the principle that the ministers at the head of the government must have the confidence of the majority of Parliament, or resign.

The rise of political parties, first the Tories and Whigs, and later the Conservatives and Liberals, contributed to the supremacy of Parliament. The King or Queen became merely a symbol of the state.

The supremacy of Parliament now means that Parliament not only makes the laws but also selects the executive officers who enforce the laws. See GREAT BRITAIN (Government).

Before 1832, legal restrictions denied many Britons the right to vote for members of the House of Commons. But, by the reform act of that year, many of the restrictions on voting were removed. By 1884, England had obtained almost complete manhood suffrage. By the Representation of the People Act of 1918, women of thirty years were given the suffrage, and finally, in 1928, all women of twenty-one years were allowed to vote. As the suffrage was extended, so also was the authority of the House of Commons over the House of Lords. At the present time, the Lords possess only a limited veto over non-money bills passed by the House of Commons.

The development of modern government in Great Britain has been an inspiration to believers in democracy. Due to love of pageantry and regard for symbols, the British people have kept their monarch. But the King or Queen is only a figurehead and convenience. Regardless of this limited monarchy, Great Britain has one of the most democratic governments in the world.

The American Contribution. The revolt of the American colonies against the British Crown and Parliament was in large measure an expression of the principle of "no taxation without representation." The Declaration of Independence of July 4, 1776, not only inspired American patriots but also electrified liberal-minded people throughout Europe. Benjamin Franklin, who came to France in the following year as representative of the new American nation, became a symbol of the virtue and liberty of the New World.

By example, the United States gave a real push to democracy in Europe. Under the new state constitutions, the suffrage in the United States was far more extensive than in Great Britain. Complete manhood suffrage was won in the United States far earlier than in Great Britain. Class distinctions were not so sharp, and



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The Press Is Free in a Democracy, and young persons such as this boy may learn early to be free-enterprisers. In a dictatorship, newspapers are permitted to print only government propaganda and stories praising the leader.

branch of government could be partly controlled by another branch. For instance, the President can veto an act of Congress, but the legislature can pass the bill into law, over the veto, by a two-thirds vote in both houses.

The United States also made a notable contribution to modern government in the development of the presidential form of government in contrast to the parliamentary form. Under the presidential form, the President or chief executive is elected by the people and holds office independently of the legislature for a definite term, which in the United States is four years. There are advantages and disadvantages to both systems. The presidential form is more rigid; the parliamentary form is more flexible. On the other hand, the presidential form gives more stability to government than the parliamentary form practiced on the European continent.

The French Revolution also made several important contributions to modern government. The Declaration of the Rights of Man, which was adopted by the French States General, summoned in 1789, served as a model bill of rights for many new governments in Europe. See FRENCH REVOLUTION.

Careers in Government

Government service is one of the great careers open to young men and women who desire to earn their living at highly useful professions. Aside from the military services there are about 2,400,000 men and women working for the Federal Government of the United States. States employ about 1,100,000. Another 3,418,000 persons are employed by local governments. More than one fourth of all government workers are teachers or other educational workers. Nearly one-fifth are civilian employees of Federal defense agencies.

The number of employees recruited each year for government service differs from office to office. The United States Department of State recruits about 300 young men and women each year for the Foreign Service. The Department of Agriculture recruits as many as 20,000 each year. The state of New York requires about 8,000 new officials a year, while all cities, towns, and villages together need 40,000 recruits.

Young men and women can find employment in public service as clerks, stenographers, mechanics, and messengers. There are also many jobs calling for skilled trades. The Government has a huge apprenticeship program for training workers. Applicants for technical positions who desire promotion eventually to the highest grades should secure a college education. If a young man is interested in aviation as a governmental career, he can apply for a post in the Federal Aviation Agency, with headquarters in Washington, D.C. This office controls the 45,000 miles of airways and the 500 airports that stretch across the United States. If a man or woman is interested in soil conservation, he or she should study chemistry and related subjects in an agricultural or forestry college, and then apply to take the examinations for the Soil Conservation Service in the

opportunity was far greater for the common man to attain success.

The constitutions of the states and the Federal Constitution of 1787 made notable contributions to the science and practice of government. First, these constitutions were written documents. They were probably the first instance of including in one document all the fundamental law providing for the organization of government.

Second, the Federal Constitution made a distinction between constitutional law and statutory law, or law passed by the legislature. Constitutional law was to be superior to statutory enactment.

Third, the Federal Constitution, by interpretation, gave the courts the right to review acts of the legislature and to declare them null and void if they conflicted with any provision of the Constitution. This unique feature of judicial review has been copied in certain other constitutions.

Fourth, the U.S. Constitution provided for a federal form of government over a large area, which eventually extended from the Atlantic to the Pacific. Many political philosophers had doubted the success of federalism over a wide territory. The distribution of powers between several governments (central and local) over a vast continent was considered a dangerous experiment. But the American federal system proved to be workable, and has been widely copied by such countries as Canada, Australia, and the Union of South Africa.

Fifth, the Constitution applied the doctrine of separation of powers. In Federal Government, power was distributed between the legislature, the executive, and the courts. The Constitution added a special device known as *checks and balances*, by which the power of one

Department of Agriculture. If the young person wishes to enter the field of education, he may find appointment as a training specialist in the Veterans Administration, or may seek work with the U.S. Office of Education. If he is interested in labor problems, after graduation from college he may seek employment in the Department of Labor. Young men and women who wish to serve their government in foreign countries may ask for employment in the many services which the State, Treasury, and Commerce departments maintain abroad. There are other positions requiring travel from state to state or city to city. Certain positions are in the state capitals or in one's own home town or city. There is a great amount of choice in job location.

Appointment as a worker entitled to promotion as the years go by generally requires the passing of a competitive examination. For the federal government such examinations are held at stated intervals in large cities, under the auspices of the United States Civil Service Commission. Similar examinations, under state commissions, are given to applicants for positions in the governments of the states. The system of competitive examinations eliminates favoritism and insures more fairness in the appointment of administrative officers than prevailed under the old "spoils system." It also tends to recruit more competent personnel for the public service. Civil-service examinations vary in nature according to the types of positions for which they are held. Each examination is designed to measure the qualifications of applicants for a particular kind of position, such as chemist, economic analyst, auditor, or Foreign Service officer. Announcements of the time and place of examinations for all positions are posted in all first- and second-class post offices for the information of all citizens. If the announcement indicates that the examination is *assembled*, it means that it consists of a written test. Applicants assemble at designated places and times to take this written test. They are later informed by letter whether they have passed the examination, in which case their names are placed on a register from which appointments are made as needed in all governmental bureaus. If the examination is *unassembled*, applicants are rated on their qualifications as shown by evidence of their school records and experience in employment.

After appointment, the new official begins at the bottom of the ladder. If the recruit proves diligent, competent, and cooperative, he may expect promotion and increases in salary at regular intervals. In performing competent and loyal service for a great democracy there is a spiritual and intellectual satisfaction that attracts young men and women of the highest character. See CIVIL SERVICE.

The United States Civil Service has provided a special arrangement to assist college graduates to enter federal service. College graduates who have a background of education or experience in the social sciences or in public administration or business administration

may take examinations for jobs as Junior Management Assistant, Junior Professional Assistant, Junior Agricultural Assistant, or Junior Scientist. Successful candidates are then introduced into various agencies at a special level. These agencies include the Bureau of the Budget, the Department of State, the Treasury Department, and the Departments of the Army, the Navy, the Air Force, Justice, the Interior, Agriculture, Commerce, Labor, and Health, Education, and Welfare. Also included are the Veterans Administration and the United States Civil Service Commission.

Besides the notices posted in the post offices, the United States Civil Service Commission and the various state commissions publish a large number of pamphlets describing the positions open to young men and women. Among these pamphlets is a guide to the principal categories of positions filled through competitive examination, under the title of *Federal Careers, A Directory for College Students*. Another pamphlet is *Futures in the Federal Government*. Both of these pamphlets can be obtained on request from the U.S. Civil Service Commission, Washington 25, D.C. The Department of State has published *Career Opportunities in the Foreign Service*. This pamphlet can be obtained by writing to the Department of State, Washington 25, D.C. Information about other areas of government can often be obtained by writing to the specific government agency.

The state civil service commissions also issue pamphlets. For example, copies of the *Careers for College Graduates in New York State Government* can be obtained from the New York State Department of Civil Service, Albany, N.Y.

KENNETH COLEGROVE

In the following pages, the author of this article compares democracy with dictatorship, largely through quotations from writings on these forms of government.

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A Person May Work Where He Pleases in a democracy. He may join a labor union, he may ask the boss for a raise, and he may decide to quit his job and go elsewhere to work. Such job freedom is unknown in fascist or communist countries.

A COMPARISON OF DEMOCRACY AND DICTATORSHIP

DEFINITION. Democracy is government by the people. The word *democracy* comes from two Greek words, *demos* (people) and *kratein* (rule). A pure democracy is a government in which all the people take a direct part in making and enforcing the laws. The New England town meeting and the form of government in a few cantons in Switzerland represent the nearest approach to pure democracy in modern times.

Representative democracy is government by the elected representatives of the people. The people do not necessarily choose all their officials. In the United States, for instance, Federal judges are appointed rather than elected.

In the purely political sense, democracy means little more than rule of the majority. But most people mean far more than majority rule when they use the term *democracy*. In the United States, Britain, and other Western democracies, citizens assume that a democratic government will protect freedom of religion, of the press, and of speech. Under the United States Constitution, these rights are the supreme liberties that are guaranteed in the Bill of Rights (the first ten amendments, adopted in 1791).

In general, democracy implies protection of the minority. As to freedom of religion, people in Western democracies believe that every man has a right to worship as he chooses. Except in a few cases, such as those involving decency or agitation for the overthrow of government by force, freedom of speech in the Western free world is almost unlimited.

The chief justification for democratic government is the idea of the dignity and worth of every human being. The underlying principle is faith in mankind. There is little point to democracy unless we believe that nearly all men and women are able to exercise good judgment, and that they possess something of value to contribute to the decisions of the group.

Another assumption of democracy, based on the principle of the innate dignity of mankind, holds that all citizens should have opportunity to share in the economic prosperity of the country.

THEORY AND PRACTICE

The following quotations give a broader idea of the meaning of democracy.

"It is essential to such a government (a democratic republic) that it be derived from the great body of the society, not from an inconsiderable proportion, or a favored class of it." **James Madison**, *The Federalist* (1788), No. 49.

"A society in which every man has a chance and knows that he has it." **James Russell Lowell**, *Democracy and Other Essays* (1886), p. 37.

"Self-government by a people is based upon moral and spiritual concepts. The Government of a free people must in itself express the highest ideals of the people. If it fails in its standards it injures the morals of the whole people. It destroys its own foundation of free government." Address of **Herbert Hoover** at Fresno, Calif., April 26, 1938.

"All, too, will bear in mind this sacred principle, that though the will of the majority is in all cases to prevail,

DEFINITION. Dictatorship is government by an absolute and uncontrolled power. Such a government is authoritarian in nature. In other words, the dictator or dictators simply assume their powers. They do not acquire their authority to govern from a grant of powers by the people. They rule regardless of public opinion.

In the twentieth century, two forms of dictatorship have emerged. One is fascism, and the other, soviet communism. The two chief examples of fascism are fascist Italy in 1922-1944, and nazi Germany in 1933-1945. The second form, soviet communism, was begun in Russia with the Bolshevik Revolution in 1917.

The Italian fascist creed viewed the state as an end in itself. This concept was borrowed from the writings of the German philosopher, Georg Hegel. Citizens were supposed to exist for the glorification of the state, and not the state for the citizens. In nazi Germany, Hitler's *Volkstaat*, or racial state, supposedly existed for the perfection of the lordly race, the so-called "Aryan" race, which the Nazis assumed had the right to rule the "slave," or non-Aryan, races.

In theory, communism implies doing away with private property, and the adoption of collective ownership of all means of production and distribution. In practice, communism generally means the so-called dictatorship of the proletariat in Soviet Russia.

The outlines of Marxian socialism were set forth in the Manifesto issued by Karl Marx and Friedrich Engels in 1848. Marx and Engels held that the capitalist system has brought about an unrelenting war between the working class and the propertied class. This struggle, according to Marxism, must lead to the breakdown of the capitalist system.

Nikolai Lenin, who planned and directed the Bolshevik Revolution of 1917, became the first dictator of Soviet Russia. He revised much of Marxian socialism. Lenin used terrorism to confuse and destroy his opponents. Under Stalin, who rose to the position of sole dictator within a few years after the death of Lenin in 1924, the use of terrorism increased.

Communism has tried to create a world revolution and to set up Soviet-controlled dictatorships everywhere.

THEORY AND PRACTICE

The following quotations illustrate the theory and practice of fascism.

"Everything is for the state, and nothing human or spiritual can exist without the state, nor have any value outside the state." **Benito Mussolini**, "The Doctrine of Fascism" in the *Enciclopedia Italiana* (1932), XIV, p. 847.

"We, National Socialists, as supporters of a new view of life . . . must make a sharp distinction between the state as a vessel and our race as its contents. This vessel has meaning only so long as it can preserve and protect the race; otherwise it is worthless. Thus the highest purpose of the folk state is to care for the preservation of our racial elements . . . We, as Aryans, can imagine as a state only the living organism of a nationality. **Adolf Hitler**, *Mein Kampf* (1934), p. 434.

"True democracy is the one that does what the people

that will, to be rightful, must be reasonable; that the minority possess their equal rights, which equal law must protect, and to violate must be oppression. Let us, then, fellow-citizens, unite with one heart and mind. Let us restore to social intercourse that harmony and affection without which liberty and even life itself are but dreary things. And let us reflect that, having banished from our land that religious intolerance under which mankind so long bled and suffered, we have yet gained little if we countenance a political intolerance as despotic, as wicked, and capable of as bitter and bloody persecutions. . . . Every difference of opinion is not a difference of principle. We have called by different names brethren of the same principle. We are all Republicans, we are all Federalists." **Thomas Jefferson**, *First Inaugural Address* (1801).

"The word democracy has been used ever since the time of Herodotus to denote that form of government in which the ruling power of the state is legally vested, not in any particular class or classes, but in the members of the community as a whole. This means, in communities which act by voting, that rule belongs to the majority, as no other method has been found for determining peaceably and legally what is to be deemed the will of the community which may not be unanimous." **James Bryce**, *Modern Democracies* (1921), Vol. I, p. 20.

"Democracy which rests merely on the will of numbers rests merely on force. If we keep the name and the idea of democracy, we must find some other basis . . . It must be a government depending on mutual exchange of ideas, on mutual criticism of the ideas interchanged, and on the common and agreed choice of the idea which emerges triumphant from the ordeal of interchange and criticism." **Ernest Barker**, *Reflections on Government* (1942), p. 36.

"The keynote of democracy as a way of life may be expressed, it seems to me, as the necessity for the participation of every mature human being in the formation of the values that regulate the living of men together; which is necessary from the standpoint of both the general social welfare and the full development of human beings as individuals." **John Dewey**, in *School and Society*, April 3, 1937.

PURPOSE OF THE STATE

According to the democratic ideal, states exist for the sake of people rather than people for the sake of states. A man's duty to support his government and serve his country grows out of the fact that his government and

want. The leaders' real task is to decide what the people should want. The masses are like the muscles, directed by the brain. One must permit the people to have 50 per cent of what they want; but the leaders must be sure that their own 50 per cent is the half that really counts." Lecture of President **Juan Perón** of Argentina before the Perónista Normal School for Leaders, February, 1953.

These quotations from Communist writers express their ideas about Communist theory and practice.

"The theory . . . may be summed up in the . . . sentence: Abolition of private property." **Marx and Engels**, *Manifesto of the Communist Party* (1848).

"The workingmen have no country . . . The proletarians have nothing to lose but their chains. They have a world to win. Workingmen of all countries, unite!" **Marx and Engels**, *Manifesto of the Communist Party* (1848).

"Democracy is but one form of state, and we Marxists are opposed to all and every kind of state." **Lenin**, *The Tasks of the Proletariat in our Revolution* (1917). "Lenin emphasized the fact that the dictatorship of the proletariat is the highest type of democracy." **Joseph Stalin**, *Leninism* (1925).

"The First World War cost capitalism the Russian Revolution and undermined the position of capitalism in the colonial areas." **Stalin**, *Sochineniya* (1948). Vol. IX, p. 108.

"The Second World War led to the establishment of peoples' democratic (Soviet) regimes in a number of countries of central and southeast Europe, and led to the victory of the great Chinese people. Can there be any doubt . . . that a third world war will be the grave not only for individual capitalist states, but also for the whole world capitalism?" **Georgi Malenkov**, *Address on the 32nd Anniversary of the Communist Revolution* (1948).

PURPOSE OF THE STATE

Fascism rejects the notion that the state exists for the sake of the people or as a means of promoting their welfare. Instead, it holds that the people exist to promote the state.

The communist proposes to use state power to destroy the capitalist system. What he expects to take its place is not clear. Bolshevik writers appear to believe that a new freedom will eventually replace the dictatorship of the proletariat.

United Press Int.

An Accused Man has the right to defend himself in the courts of a democracy. He may employ a lawyer to direct his defense, and if he is too poor to hire a lawyer the court will furnish him with one. In a dictatorship, a man is accused only after the dictator's puppet courts have already decided he is guilty. The defendant is expected to confess, not deny, the crime.



his country are serving him. In some form or other, the idea that every person counts for something has been the heart of modern democratic government.

The following quotations illustrate and develop the idea that democratic governments are created by the people to serve their purposes, and that the people are free to change their system of government.

"The greatest happiness of the greatest number is the foundation of morals and legislation." **Jeremy Bentham**, *Works* (1843), X, p. 142.

"We, the people of the United States, in order to form a more perfect Union, establish justice, insure domestic tranquillity, provide for the common defense, promote the general welfare, and secure the blessings of liberty to ourselves and our posterity, do ordain and establish this constitution for the United States of America." **Preamble to the United States Constitution** (1789).

"We hold these truths to be self-evident: That all men are created equal; that they are endowed by their Creator with certain unalienable rights; that among these are life, liberty, and the pursuit of happiness. That, to secure these rights, governments are instituted among men, deriving their just powers from the consent of the governed; that, whenever any form of government becomes destructive of these ends, it is the right of the people to alter or to abolish it, and to institute a new government, laying its foundation on such principles, and organizing its powers in such form, as to them shall seem most likely to effect their safety and happiness. Prudence, indeed, will dictate that governments long established should not be changed for light or transient causes." **Declaration of Independence**, July 4, 1776.

"The aim of every political association is the preservation of the natural and imprescriptible rights of man. These rights are liberty, property, security, and resistance to oppression." **Declaration of the Rights of Man and Citizen in the French Constitution of 1791**.

LEADERSHIP

In a democracy, everyone has some opportunity to exercise leadership. Every citizen can lead by calling the attention of his fellow citizens to things which they ought to consider in making their decisions.

The following quotations show the various ideas among dictatorships regarding the purpose of the state.

"The state is resuming its right and its prestige as the sole and supreme interpreter of the needs of society." Address of **Mussolini** to the Fascist Grand Council, March 18, 1934.

"The German Reich, as a state, must include all Germans, with the duty of not only preserving the most valuable racial elements among that people, but also to lead them slowly and surely to a dominating position." **Hitler**, *Mein Kampf* (1934), p. 439.

"In its exploitation of the state apparatus for personal goals, the Soviet bureaucracy is similar to every other bureaucracy." **Leon Trotsky**, *The Revolution Betrayed* (1937).

"The aim of the Communist International is to organize the armed struggle for the overthrow of the international bourgeoisie (middle class) and the establishment of an international Soviet republic as a transition to the complete abolition of the capitalist state. The Communist International considers the dictatorship of the proletariat an essential means for the liberation of humanity from the horrors of capitalism and regards the Soviet form of government as the historic necessity for this dictatorship." Theses of the **Second Congress of the Communist International** (1920).

"The forms of government of all countries of the world fall fundamentally into three categories: (a) republics under the dictatorship of the capitalist class; (b) republics under the dictatorship of the proletariat; and (c) republics under the joint dictatorship of several revolutionary classes . . . The second form of republic is fermenting in the various capitalist countries, besides its realization in the Soviet Union . . . That is to say that we cannot separate ourselves from the assistance of Soviet Russia." **Mao Tse-tung**, *China's New Democracy* (1940).

LEADERSHIP

The fascist principle of leadership is uppermost in fascist tactics. At the top of the state is one man—the leader, or *fuehrer*, the dictator—who always leads. At the bottom are the masses, who only follow.

Marxian theorists have taken it for granted that the

Monkmeyer



A Policeman Is a Friend in a democracy. He is on duty to help all citizens, and to enforce laws for the protection of life, liberty, and property. In a dictatorship, or "police state," a policeman is a man to be feared by all who may criticize the government, listen to foreign radio broadcasts, or otherwise offend the dictator.

There is an important place for the expert in a democracy, but he must usually follow the policies which have been approved by the people or their representatives. Sometimes this means loss of efficiency, but democracies are generally ready to accept this loss rather than give up the idea that everyone should share in the exercise of leadership.

The following quotations give views of the democratic concept of leadership.

"A great man may . . . do much to create a pattern for the people of what statesmanship should be. If his honor is unblemished, his ideals high, his temper large, tolerant and sympathetic, his example is sure to tell. Others try to live up to it." **James Bryce**, *Modern Democracies* (1921), II, p. 614.

"The working men and women must insure that government, backed by the military strength adequate to secure our own political and territorial integrity, offer the world a leadership of constructive ideas designed to advance the goal of universal progress and enduring peace . . ." Address of **General Douglas MacArthur** at Detroit, May 16, 1952.

THE CITIZEN AND THE STATE

Under a democratic constitution, the powers of the government are in some degree limited. The Constitution of the United States gives specific powers to the national government. The first 10 amendments place restrictions upon the national government, while later amendments place limits on the state governments.

The following quotations indicate some ideas about limits on governmental power.

"There is a circle around every individual human being, which no government, be it that of one, of a few, or of the many, ought to be permitted to overstep." **John Stuart Mill**, *Political Economy* (1848), II, p. 506.

"In framing a government which is to be administered by men over men, the great difficulty lies in this: you must first enable the government to control the governed; and in the next place oblige it to control itself." **James Madison** in *The Federalist* (1788), No. 51.

"No person shall be . . . deprived of life, liberty or property, without due process of law, nor shall private property be taken for public use without just compensation." **Constitution of the United States**, Amendment 5 (1791).

FREEDOM OF SPEECH

All democracies favor freedom of speech, but they place some limits upon this freedom, as shown by the laws against libel and slander. Without free speech the citizens of a democracy cannot learn the things they need to know in order to vote intelligently.

It is clearly risky to say that government should have no control over what is said or printed. On the other hand, if a government is allowed to exercise this kind of control, it may use that power to shut off criticism of the government's own policies and thus maintain itself in office. Democratic countries generally prefer to accept the risks of leaving speech and the press almost completely free. The following quotations develop some important ideas on this subject.

"Give me the liberty to know, to utter, and to argue freely according to conscience, above all liberties." **John Milton**, *Areopagitica* (1644).

"That the freedom of speech and debates or proceedings in parliament ought not to be impeached or ques-

leaders of the communist revolution should be the more advanced workers and the intellectuals of the party. The "soviet man" has been trained to follow implicitly the leader and the "party line."

The following quotations will illustrate the theory and practice of leadership in modern dictatorships.

"The law and the will of Der Führer are one." Address by **Hermann Goering**, reported by *The New York Times*, July 13, 1943.

"There has developed since Lenin's death a real cult of this acknowledged leader of the movement to which the Party (Communist) is pledged. The Party is often spoken of as the 'Lenin Party' . . . The Communists have recognized from the beginning the importance of the element of individual leadership." **Samuel N. Harper**, *Civic Training in Soviet Russia* (1929), p. 37.

"No, comrades, this is not the way. In this matter the masses are wrong. All the correct opinions of the masses, we the leaders must carry out loyally, but not the incorrect ones." **Mao Tse-tung** before the Communist Chinese People's Assembly in Shihchiachuang in April, 1948.

THE CITIZEN AND THE STATE

Under dictatorship, the citizen belongs to the state. He has no civil liberties. Dictators tell the individual what he may read, where he may travel, what he may listen to, or where and how he must work. Their orders have extended even into family life.

The following quotations show authoritarian theory and practice.

"Men never do good except by necessity; but where there is liberty and license everything falls into confusion and disorder." **Machiavelli**, *Discorsi* (1519), chapter 3.

"Men are tired of liberty." **Mussolini**, *Force and Consent* (1923).

"If the Greeks perished through their slavery, one thing is still more certain; we shall perish through lack of slavery. To the essence of culture, slavery is innate." **Nietzsche**, *Early Greek Philosophy and Other Essays* (1885), p. vii.

"The promise to give the Soviet people freedom to vote for those whom they want to elect is rather a poetic figure than a political formula. The Soviet people will have the right to choose their 'representatives' only from among candidates whom the central and local leaders present to them under the flag of the party." **Leon Trotsky**, *The Revolution Betrayed* (1937), p. 265.

FREEDOM OF SPEECH

Dictatorship has no use for the idea of free speech. Almost the first step of fascist or communist dictators on coming to power is to suppress all publications which do not support their regime. Spies and secret police are planted everywhere, and people who have anything to complain about learn to keep quiet. Bookstalls, newsstands, and the air waves are flooded with official propaganda. Ideas which are in any way critical of the rulers are rigorously suppressed. Dictatorship requires unity of belief. Words that might cause doubt are dangerous, since they may give rise to thinking. And dictators do not want people to think.

The following quotations show the contempt of both fascists and communists for free speech, and their intention to suppress it.

"Italian journalism is free because it serves but one cause and regime." Address of **Mussolini** to Italian journalists, October 1, 1928.

"Whoever repeats as news any information from foreign radio stations will be punished with up to two years in

tioned in any court or place out of parliament." **British Bill of Rights** (1689).

"Congress shall make no law . . . abridging the freedom of speech or of the press, or the right of the people peaceably to assemble and to petition the government for a redress of grievances." **Constitution of the United States**, Amendment 1 (1791).

"The free communication of ideas and opinions is one of the most precious of the rights of man; every citizen then can freely speak, write, and print, subject to responsibility for the abuse of this freedom in cases determined by law." **French Declaration of the Rights of Man and Citizen** (1791), Article XI.

PUBLIC OPINION AND POLITICAL PARTIES

In the democracies of ancient times, the people were not allowed much disagreement with the government. In Athens, political leaders who opposed the ideas and policies adopted by the majority were often ostracized, that is, made to leave the country. Leaders of the Athenian government feared that strong and intelligent opposition would destroy the unity of their city-state.

In the United States, Great Britain, and many other countries, the idea has grown up that there *ought* to be a strong and outspoken opposition party or parties. But in wartime or a national emergency, the leaders of all parties often join forces for national defense.

Some of the problems that democracies face in regard to public opinion and political parties, as well as some ideas about the principles which should be followed in dealing with them, are indicated in the following quotations.

"No government ought to be without censors (critics of the government) . . . If virtuous, it need not fear the fair operation of attack and defense." **Thomas Jefferson**, in a letter to George Washington, September 9, 1792.

"As the excellence of public opinion—its good sense, its tolerance, its pervasive activity—is the real test of a nation's fitness for self-government, so the power it exerts . . . is the best guarantee for the smooth and successful working of popular government, and the best safeguard against revolutionary violence." **James Bryce**, *Modern Democracies* (1921), I, p. 182.

"The existence of a party of opposition, with a program fairly within the limits of a possible public opinion, is a bulwark against the tyranny, not only of a despot, but also of a fanatical popular majority. It becomes a rallying place for sober common sense when a policy is carried too far. It is ballast for the ship of state and it forces the rulers to justify their conduct in the face of constant criticism." **A. Lawrence Lowell**, *Public Opinion and Popular Government* (1921), p. 88.

"Ours is a government of political parties. Democracy cannot function without party government. But good government is good politics—or it should be. Political parties are organizations for adult education on issues in reforms and in problems of government and the election of decent public officials. The proper organization and conduct of political parties is a public service." Address of **Herbert Hoover** at Syracuse University on November 12, 1937.

"I am of the opinion that the state needs an opposition and that the latter has a political function in the state. Only by the juxtaposition of a Government majority and an opposition minority can true progress and an acclimation to democratic thought be achieved." Address of Federal Chancellor **Konrad Adenauer** before the Bundestag of the German Federal Republic on September 20, 1949.

prison, providing the items are injurious to the welfare of the Reich, the reputation of the government, the Nazi party or any of its associated organizations. If the news is published the punishment is from three months to five years in prison." *Deutsches Recht*, IX, (1939), p. 89.

"It would be absurd to grant freedom of assembly and of street processions to monarchists. Incongruous on our streets would be people waving the Tsarist flag and singing in Sovietland 'God Save the Tsar'. . . He who would attempt to preach the overthrow of the socialist system . . . will appear to the peoples of the Union as a criminal, having no right to enjoy the liberties granted by the constitution." Russian newspaper *Izvestia*, August 6, 1936.

"We will inculcate the masses with the spirit necessary to travel the heroic path on which they will be led. We will do this by controlling the press, movies, radio, books, and education. Our generation will be sacrificed for an idea—the Argentine fatherland. Viva Argentina!" Proclamation approved by Dictator **Juan Perón** in 1943.

PUBLIC OPINION AND POLITICAL PARTIES

The fascist or communist state secures unity by wiping out opposition. It therefore cannot tolerate any political parties except the one party that holds supreme control. Other parties are banned.

The ideal of the supremacy of the party, side by side with the ideal of the supremacy of the state, has led to some confusion in fascist thinking. Sometimes the party is presented as the highest authority, with the state as the instrument through which the party achieves its purpose. Sometimes the party is presented as serving the state and as existing for that purpose.

Communism, too, makes no place for opposing political parties. Bolsheviks see their system as depending finally upon mass support. Now and then they are even willing to make a few concessions to popular desires, but this is temporary. In general, the communist looks upon public opinion as something to be controlled.

The fascist and communist attitudes toward public opinion and political parties are shown in the following quotations.

"All political parties, all anti-Fascist political organizations, and others of a suspected character have been suppressed." *Popolo d'Italia*, November 11, 1925.

"The National Socialist Party is the state . . . Now we must destroy the last vestiges of democracy, especially the methods of voting and reaching decisions by majorities." **Hitler**, Address to Reichstag, July 7, 1933.

"The class which took political power into its hands did so knowing it took power single-handed. This is a part of the concept of dictatorship of the proletariat. This concept has meaning only when the single class knows that it alone takes political power into its hands, and does not deceive either itself or others by fine speeches about 'popular, generally-elected, sanctified by all the people' authority." Speech by **Lenin** (March 27, 1921), *Selected Works* (1943), Vol. IX, p. 137.

"The dictatorship of the proletariat can be complete only if it be led by a single party, the Communist Party, which does not and must not share leadership with any other party." **Stalin**, *Leninism* (1925), I, p. 110.

"The Communist Party is deliberately held down in numbers through a policy of severe entrance requirements, rigid discipline, leading to fairly frequent expulsions of members and occasional wholesale purges, when Party members whose conduct is found unbecoming a Communist are dropped from the ranks or reduced to the rating of 'candidates' or 'sympathizers'." **William Henry Chamberlin**, *Russia's Iron Age* (1934), p. 37.

"The Communist party, armed with the revolutionary

RELIGION

Most democratic countries have taken the position that government will not interfere in religious affairs. Some people think that democracy should give even more positive protection to religious freedom by acting to prevent discrimination against religious groups.

In the United States, the First Amendment to the Constitution completely separates church and state. Congress may not establish a state church. The constitutions of the various states place similar prohibitions upon the state legislatures.

The following quotations are examples of democratic ideas on the relation of government to religion.

"Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof." **Constitution of the United States, Amendment I (1791).**

"No one shall be disturbed on account of his opinions, even religious, provided their manifestation does not derange the public order established by law." **French Declaration of the Rights of Man and Citizen (1791), Article X.**

"Our civil rights have no dependence on our religious opinions, any more than our opinions in physics or geometry. . . . The opinions of men are not the object of civil government." Virginia Bill for Establishing Religious Freedom (1786), drafted by **Thomas Jefferson.**

"Today religion is still free within our borders. It must ever remain so." **Franklin D. Roosevelt, June 14, 1936.**

RACE

The area of race relations is probably the field in which democratic countries have most often and most seriously failed to live up to their ideals. Most democratic governments tolerate some discriminations on the basis of race, and sometimes even enact them into law. But the meaning of the democratic ideal on this point is perfectly clear, and the violations are widely recognized as violations even by those who practice them. Compared with the history of modern dictatorships, the rec-

theory of Marx-Engels-Lenin-Stalin, made wise by a half-century-long struggle for the interests of the working class, knows how to conduct its affairs in order to secure the building of a Communist society. The Central Committee of our party and the Soviet Government have been trained for governing the country in the great school of Lenin and Stalin." Oration of Deputy-Premier **Lavrenti P. Beria** at funeral of Stalin, March 9, 1953.

RELIGION

Fascism usually has no particular quarrel with religion. But fascism insists that the church, like everything else, must accommodate itself to the state's program. As a result, nearly all fascist states have been opposed by some courageous religious leaders.

Communist Russia and its satellites carry on a violent war against religion. Communism promotes atheism, and seeks to set itself up as a substitute for religion, with communist dictators as its "gods."

The following quotations show the negative attitude of all modern dictatorships toward religion.

"I believe in no one of the earth except Adolf Hitler. I believe in a Lord God who created me and guides us; and I believe that this Lord God sent us Adolf Hitler." **Robert Ley, *Kulturkampf*, April 15, 1938.**

"Religion is the sigh of the oppressed creature, the feelings of a heartless world, just as it is the spirit of unspiritual conditions. It is the opium of the people." **Karl Marx, *Introduction to a Critique of the Hegelian Philosophy of Right* (1844), p. 57.**

"To the poor worker, religion teaches passivity and patience in earthly life, consoling him with the hope of a heavenly reward. To him who lives on the labor of others, religion teaches benevolence in earthly life, offering him a cheap justification for his exploitation of his fellowmen and selling him a ticket to heaven at a reduced rate." **Jaroslavsky, *Thoughts of Lenin about Religion* (1925), p. 10.**

RACE

There is no necessary connection between Fascism and racial intolerance. But Fascism comes to power by

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Soapbox Orators may talk and anyone may listen, in a democracy. Freedom of speech and of assembly are cornerstones of democratic freedom. In a communist or fascist country, anyone so rash as to stand up and express unpopular views would be executed or sent to a slave-labor camp.



ord of the democracies is remarkably clean. Most democratic countries have constitutional and statutory laws asserting racial equality. Democratic governments also refrain from persecution of races or from throwing members of unfavored races into slave-labor camps, as is done in Soviet Russia and her satellite countries, and in Communist China.

The following quotations show clearly the democratic ideals with respect to race.

"The right of citizens of the United States to vote shall not be denied or abridged by the United States or by any state on account of race, color, or previous condition of servitude." **Constitution of the United States**, Amendment 15 (1868).

"It requires no argument to show that the right to work for a living in the common occupations of the community is of the very essence of the personal freedom and opportunity that it was the purpose of the (Fourteenth) Amendment to secure . . . If this could be refused solely upon the ground of race or nationality, the prohibition of the denial to any person of the equal protection of the laws would be a barren form of words." **Justice Charles Evans Hughes**, in the case of *Truax v. Raich* (1915), 239 U.S. Reports, 33.

"Conceiving the defense of freedom like freedom itself, to be one and indivisible, we hold all continents and peoples in equal regard and honor. We reject any insinuation that one race or another, one people or another, is in any sense inferior or expendable." Inaugural address of **President Dwight D. Eisenhower**, on January 20, 1953.

EDUCATION

Democracy depends upon the kind of education which teaches young persons to examine thoughtfully the life about them, rather than simply to accept existing institutions. Children must be taught to think for themselves, rather than to depend upon decisions that others have reached.

The importance of education to democratic government, and some ideas about the kind of education a democracy needs, are brought out in the following quotations.

"Religion, morality and knowledge being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged." **Thomas Jefferson** in the Northwest Ordinance (1787).

"The first element of good government, therefore, being the virtue and intelligence of the human beings composing the community, the most important point of excellence which any form of government can possess is to promote the virtue and intelligence of the people themselves." **John Stuart Mill**, *Representative Government* (1860), p. 12.

"The devotion of democracy to education is a familiar fact. The superficial explanation is that a government resting upon popular suffrage cannot be successful unless those who elect and who obey their government are educated. Since a democratic society repudiates the principle of external authority, it must find a substitute in voluntary disposition and interest; these can be created only by education. But there is a deeper explanation. A democracy is more than a form of government; it is primarily a mode of associated living, of conjoint communicated experience. The extension of space of the number of individuals who participate in an interest so that each has to refer his own action to that of others, and to consider the action of others to give point and direction to his own, is equivalent to the breaking down of those barriers of

playing upon the deep-seated prejudices of the people, and race prejudice is one of the strongest. Adolf Hitler built up his power partly by cultivation of German prejudice against the Jews. There is no such thing as a Jewish race, but anti-Semites prefer to think there is.

According to the original Bolshevik ideas, racial discrimination was to be illegal, and punishable by law. Actually, Russians have tried to wipe out the Baltic peoples. They have killed and persecuted large numbers of Jews, especially during the political purges of the 1930's. Persecution of Jews in Russia was reported to have begun again in the 1950's. Communists who live in democracies are taught to stir up race hatred whenever possible, in efforts to discredit the democratic way of life.

The following quotations illustrate fascist and communist views on race.

"Our whole civilization and culture today is the work of one definite race of men, the Teutonic." **Houston Stewart Chamberlain**, *Foundations of the Nineteenth Century* (1904), I, p. lxvii.

"Our folk philosophy recognizes the significance of humanity in its original racial elements . . . Consequently it believes in no way in the equality of races, but in the victory of the better and stronger, and demands the subordination of the worse and the weaker." **Hitler**, *Mein Kampf* (1934), p. 420.

"The German people alone will be a people of warriors; the other nations will be helots, working for the Teuton warrior caste." Conversation with **Hitler**, related by Otto Strasser in *Hitler and I* (1940), p. 214.

"Lenin never said that national differences must disappear and national languages become fused into one common language within the boundaries of a single state, before the victory of socialism on a world scale. Lenin, on the contrary, said something diametrically opposite, namely, that national and state differences among peoples and countries . . . will continue to exist for a very long time, even after the dictatorship of the proletariat has been established on a world scale." Report of the **Sixteenth Congress of the Communist Party** (1930).

EDUCATION

In the fascist state, the major task of education is to drill into the young a blind loyalty to the regime in power. Fascism also seeks to teach children enough so that they can serve the state in their work, and at the same time to keep them ignorant enough never to doubt the official teachings.

Large sums will be spent upon education if the program of the dictator or the party calls for the services of many able and skilled people, as in Nazi Germany. A program which makes no particular demands upon the intelligence of the people, as in Franco's Spain, can safely rely upon the simple absence of schooling to maintain among the masses the necessary degree of ignorance.

Soviet Russia has greatly reduced illiteracy and in many places almost wiped it out. But Russian education must be criticized for its insistence that children must be taught to accept without question the official point of view on any matter.

In its first few years, Soviet Russia was concerned with making sure that the children of workers were educated. Attendance at free schools was compulsory.

Russian policy in education changed sharply during World War II. Colleges and universities began charging tuition, so that only the children of bureaucrats could

class, race, and national territory which kept men from perceiving the full import of their activity." **John Dewey**, *Democracy and Education* (1916), p. 101.

"The reciprocal relation between the ethics of the public and ethics of public representatives has been repeatedly emphasized . . . The nation's debt to the churches, the schools, the homes and the great moral teachers is clearly recognized. The morality of the state is only partly subject to its own control. The responsibility of religious and educational institutions and of parents is enormous."

Senator Paul H. Douglas in *Report on Ethical Standards in Government* (1951), p. 7.

WAR AND PEACE

The more democratic a country becomes, the less likely it is to want war. In any war, it is the common man who sacrifices most and gains least. But democratic countries have always run grave risks of attack by dictatorships. A dictator-ruled country can plan a war, mobilize its armies, and go into action much more quickly than can a democracy, where such actions are the results of legal action by the people. For this reason, some people believe that no democratic country can be safe until democracy has developed in all nations.

The following quotations point out the attitude of democratic countries toward war and peace.

"I consider how mankind may be connected, like one great family, in fraternal ties. I indulge a fond, perhaps an enthusiastic idea, that as the world is much less barbarous than it has been, its melioration must still be progressive . . . that the period is not very remote when the benefits of a liberal and free commerce will pretty generally succeed to the devastation of war. And I most sincerely and devoutly wish that the exertions of those having this view may effect what human nature cries aloud for—a general peace." Maxims of **George Washington**.

"No one who really comprehends the spirit of the great people for whom we are appointed to speak can fail to perceive that their passion is for peace, their genius best

get into some schools. Special academies were set up for children of officials and military leaders. There were several signs that a new ruling class might be securing the same monopoly of education which communists have always charged that the rulers of capitalist countries maintain.

The following quotations show the theory and practice of education under both fascism and communism.

"The consummation of the racial state's educational work must consist in burning a sense of race into the hearts and brains of the youth . . . No boy and no girl must leave school without having been brought to an ultimate comprehension of the necessity and nature of blood-purity." **Adolf Hitler**, *Mein Kampf* (1934), p. 475.

"The liquidation of illiteracy is considered part of political and educational work. Lenin had said that with illiteracy there could be no full understanding of political issues and therefore no effective participation in political activity. Not even the slogans would have their full effect if the workmen or peasants could not read the banners under which they were marching." **Samuel N. Harper**, *Civic Training in Soviet Russia* (1929), p. 292.

WAR AND PEACE

War is the very heart of the fascist system. Fascism keeps a country permanently on a wartime footing, and peace is only an interval for recovery or preparation.

Communists used to claim that if private property could be abolished, no nation would have any reason for trying to dominate the people of other lands. But during and after World War II, Communist Russia itself showed a strong spirit of imperialism.

The following quotations show the theoretical position of modern dictatorships on war and peace.

"The measure of the strength of a people is always and exclusively its readiness for military conflict." **Alfred Rosenberg**, in *Völkischer Beobachter*, August 1, 1931.

"War is the Father of Creation and the Mother of Culture. Rivalry for supremacy does for the State what

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Freedom of Religion Goes

when communists take over. Roman Catholic Cardinal Mindszenty is shown here being brought before the communist court of Hungary to hear his sentence of life imprisonment on trumped-up charges. Democratic nations guard and preserve the right to worship as one may please, or not to worship. Freedom of religion is one of the basic guarantees in all democratic constitutions.



displayed in the practice of the arts of peace. Great democracies are not belligerent. They do not seek or desire war. Their thought is of individual liberty and of the free labor that supports life and the uncensored thought that quickens it. Conquest and dominion are not in our reckoning, or agreeable for our principles. But just because we demand unmolested development and the undisturbed government of our own lives upon our own principles of right and liberty, we resent, from whatever quarter it may come, the aggression we ourselves will not practice." Annual Message to Congress of **President Woodrow Wilson**, December 7, 1915.

"We not only desire peace with the world, but to see peace maintained throughout the world. We wish to advance the reign of justice and reason toward the extinction of force." Inaugural Address of **President Herbert Hoover**, March 4, 1929.

"In the future days which we seek to make secure, we look forward to a world founded upon four essential human freedoms. The first is freedom of speech and expression—everywhere in the world. The second is freedom of every person to worship God in his own way . . . The third is freedom from want, which translated into world terms, means economic understanding, which will secure to every nation a healthy peacetime life for its inhabitants . . . The fourth is freedom from fear, which . . . means a world-wide reduction of armaments to such a point and in such a thorough fashion that no nation will be in a position to commit an act of physical aggression against any neighbor—anywhere in the world." **Franklin D. Roosevelt**, Message to Congress, January 2, 1941.

"The hope for democracy is the victory of those powers which believe in our way of life, and in a peace that really assures the principle of free enterprise throughout the world, the reopening of the trade routes, the re-establishment of the open markets, and the rebirth of the confidence in one another." **Wendell L. Willkie**, Jan. 12, 1941.

Related Articles. See the GOVERNMENT section in the READING AND STUDY GUIDE for detailed lists of articles in WORLD BOOK which relate to Government. See also the Government section in each state, province, and country article, such as ALABAMA (Government). See also the following articles:

Advisory Council	Freedom	Nazism
Aristocracy	Freedom of	New Deal
Autocracy	Religion	Nihilism
Autonomy	Freedom of	Oligarchy
Canada,	Speech	Police State
Government of	Freedom of the	Political Science
Citizenship	Press	Radicalism
City	Geopolitics	Representative
City and Local	Government	Government
Governments	Ownership	Republic
Civics	Government	Revolution
Communism	Regulation	Satellite
County	Ideology	Socialism
Government	Imperialism	Sovereignty
De Facto	International	State Government
Government	Relations	Syndicalism
Democracy	Law	Theocracy
Despotism	Legislature	Totalitarianism
Dictator	Metropolitan	Tyranny
Fascism	Area	United Nations
Fiat	Monarchy	United States,
Foreign Policy	Nationalism	Government of

Outline

- I. "Of the People, by the People, for the People"
- II. When Tyrants Rule
- III. Modern Ideas of Government
 - A. Background of Modern Thought
 - B. From Mixed Republic to Representative Democracy

struggling against adversity does for the individual." **Japanese Army Pamphlet**, October, 1934.

"All soil and industrial property of inhabitants of non-German origin will be confiscated without exception and distributed primarily among the worthy members of the party and soldiers who were accorded honors for bravery in this war. Thus, a new aristocracy of German masters (*Herrenvolk*) will be created. This aristocracy will have slaves assigned to it, these slaves to be their property and to consist of landless, non-German nationals . . . we actually have in mind a modern form of medieval slavery which we must and will introduce . . . These slaves will by no means be denied the blessings of illiteracy; higher education will, in future, be reserved only for the German population of Europe." **Walther Darre**, May, 1940.

"Imperialist wars therefore become inevitable, wars for markets for the sale of goods, wars for spheres for investing capital, for raw material and for labor power, wars for world domination and for power over small and weak nations." **Program of the Communist Party**, adopted at the Seventh Congress of the All-Russian Communist Party, 1919.

"Under the leadership of the great Stalin, a mighty camp of peace, democracy, and socialism has been set up. In that camp, in close fraternal unity, march the great Chinese people. The fraternal peoples of Poland, Czechoslovakia, Bulgaria, Rumania, Albania, German Democratic Republic (East Germany) and the Mongolian People's Republic also march. In a stubborn battle, the heroic Korean people are defending the independence of their motherland. A courageous fight is being waged for freedom and national independence by the people of Vietnam (French Indochina). It is our sacred task to preserve and consolidate the greatest attainment of the people—the camp of peace, democracy and socialism—to strengthen the ties, friendship and solidarity of the peoples of the democratic bloc." **Georgi M. Malenkov**, March 9, 1953.

- C. Dignity of Mankind
- D. Opposition Parties

- E. Misuse of Term "Democracy"

IV. How Government Developed

- A. Theories About Origin
- B. Beginnings of Government in the Family
- C. The Greek City-State
- D. Roman Government
- E. The National State

- F. The British Parliament
- G. The American Contribution
- H. The French Revolution

V. Careers in Government

VI. A Comparison of Democracy and Dictatorship

- A. Definition
- B. Theory and Practice
- C. Purpose of the State
- D. Leadership
- E. The Citizen and the State
- F. Freedom of Speech
- G. Public Opinion and Political Parties
- H. Religion
- I. Race
- J. Education
- K. War and Peace

Questions

- What are the responsibilities of a citizen in a democracy?
- How did the Greek city-states and the Roman Empire contribute to the advancement of democracy?
- How has the form of government changed in the United States since the days of the Founding Fathers?
- What are four theories on the origin of government?
- What is the purpose of education in a dictatorship?
- What is the purpose of education in a democracy?
- Why do dictators suppress free speech?
- What did the United States Constitution contribute to the science of government?
- Why is government necessary?
- What purpose does a state serve in a dictatorship?
- What purpose does it serve in a democracy?
- What four freedoms did Franklin D. Roosevelt state?

GOVERNMENT OWNERSHIP is the ownership and operation by a governmental unit of some service or productive enterprise for the benefit of the public. It is also called *public ownership*. Generally speaking, government ownership occurs whenever a vital economic service cannot be profitably provided by a private company. It is often undertaken so that the public may be able to purchase a service at cost. In a few cases, it earns revenue for the government.

Most Europeans accept government ownership more readily than people in the United States. In many cases, European governments own the transportation and communication systems. They may also control manufacturing firms such as automobile companies. In many countries outside of Europe, such as Australia, Brazil, Canada, Chile, Japan, and New Zealand, strong political parties favor government ownership. In the United States, government ownership at a local level includes some public utilities; at the state level, the public-school system; and, at the national level, the postal service. The Tennessee Valley Authority is an example of government ownership (see **TENNESSEE VALLEY AUTHORITY**).

See also **PUBLIC UTILITY**; **SOCIALISM**.

GOVERNMENT PRINTING OFFICE (GPO) is the largest and best-equipped printing plant in the world. It prints and binds publications for the federal government, supplies paper and ink for government offices, and distributes publications to the public, if they are not confidential. The *Public Printer* directs the GPO. The *Superintendent of Documents* supervises sales.

In one year, the GPO may produce as many as 500,000,000 copies of various publications, including more than 6,000,000 copies of *The Congressional Record* (see **CONGRESSIONAL RECORD**). The Division of Public Documents may send out as many as 131,800,000 publications in one year. Congress created the GPO in 1860. See also **SUPERINTENDENT OF DOCUMENTS**.

GOVERNMENT REGULATION is the process by which a government controls economic activities of public interest in order to protect the consumer or general public. Such activities include railroads, television and radio broadcasting, and telephone and telegraph communications, as well as public utilities of all types. Government regulation is an alternative to government ownership (see **GOVERNMENT OWNERSHIP**). Americans prefer government regulation, because it preserves the benefits resulting from private initiative and enterprise, as well as protecting the public against monopolies (see **MONOPOLY**).

Regulation may check abuses, such as stock frauds and adulteration of foods. It usually concerns the rates charged and the types of service rendered, but it may also deal with safety in transport. In the United States, regulation is usually handled by *commissions* appointed by the government. Commissions include the Federal Communications Commission, Federal Trade Commission, and Interstate Commerce Commission. See the separate articles in **WORLD BOOK** on each of these commissions.

GOVERNMENT SERVICE. See **CIVIL SERVICE**; **DIPLOMACY**.

GOVERNOR, in the United States, is the chief executive of a state. He serves for two years in 16 states, and

for four years in the others. His duties, like those of the President of the United States, are partly executive, partly legislative, and partly judicial.

As the chief executive, the governor has broad powers of supervision over administrative agencies. He can appoint persons to many government positions, or remove them. He has the state militia and state police at his disposal. He has enormous financial responsibilities in preparing the budget for the legislature and in supervising its administration.

As the chief legislator, the governor recommends a program to the legislature, and may veto its actions. In most states, he may even veto specific items in appropriation bills. He may call the legislature into special sessions. The legislature gives him authority to fill in the details of general statutes.

The governor's judicial powers allow him to grant pardons, reprieves, commutations, and paroles. He may return to other states fugitives who have escaped from justice there. He may fill judicial vacancies.

Salaries of governors range from \$10,000 to \$50,000 a year. Most states also make provision for some expenses, and all states provide official residences.

A governor may be impeached and tried by the legislature. He can be recalled from office in special elections in 11 states. In all but 11 states, the lieutenant governor succeeds to the office if the governor dies or cannot perform his duties.

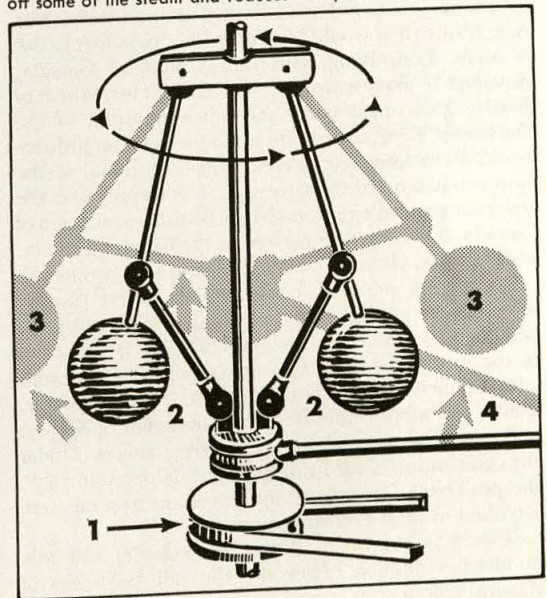
In early state constitutions, the governorship was a weak position. Experience with royal governors made the people wary of giving the office too much power. But the governorship has become a powerful post, often leading to higher political office.

DAVID FELLMAN

See also **ADDRESS, FORM OF**; **LIEUTENANT GOVERNOR**.

GOVERNOR is a mechanical device used to control the speed of engines and motors. There are several dif-

Governors Control Engine Speeds. The belt wheel (1) from the engine rotates the balls (2). As the engine speed increases, the balls move upward (3). This raises a lever (4) which shuts off some of the steam and reduces the speed.



GOVERNOR GENERAL

ferent designs, but the basic principles of governors are the same.

A *steam-engine governor* has a small upright shaft connected to the engine. Two metal balls hang from the shaft by smaller rods. When the engine runs, it spins the shaft, and centrifugal force pulls the metal balls outward from the shaft. When the balls swing outward, they partially close a valve to the cylinder, which cuts down the amount and pressure of steam going into the cylinder. The speed of the engine is reduced. When the speed decreases, the centrifugal force becomes less, the balls move in closer to the shaft, and another valve opens to let in more steam.

Several automobile governors also operate by centrifugal force. The engine speed swings metal weights out from a shaft. The weights close a valve that leads from the carburetor. The governor is located between the carburetor and the intake to the cylinders. Another type, called the *McCanna suction governor*, is placed on the carburetor opening. As the gasoline rushes through, it forces a perforated disk down against a spring. This action partially closes the opening and cuts down the flow of the gasoline when a certain engine speed is reached.

E. A. FESSENDEN

GOVERNOR GENERAL is an executive official who directs the activities of deputy or lieutenant governors. The chief executive officer of a possession is often known as a governor general. He directly represents the head of the government that controls the possession. Governors general administer the possessions of Great Britain, The Netherlands, Portugal, Spain, and overseas departments and territories of France.

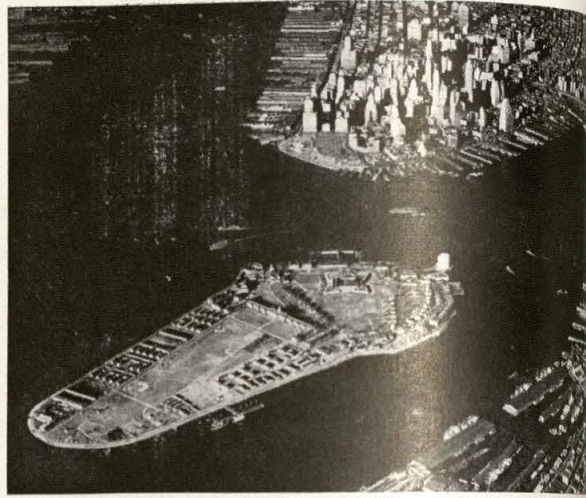
The powers of the governor general vary according to the laws of different countries. For example, the governor-general of Canada has no real authority. His powers are like those of the monarch in the government of Great Britain. But in some possessions or colonies, a governor general has almost the power of an absolute monarch.

At times, governors general have asserted themselves more firmly than would be proper for a monarch to do. In 1926, Lord Byng, Governor-General of Canada, provoked a grave constitutional crisis. He refused to dissolve Parliament when the prime minister, W. L. Mackenzie King, asked him to do so. Such an attitude would have been considered unconstitutional if the monarch had acted the same way. The dispute over the governor general's powers led to British recognition of Canada as a voluntary partner in the Commonwealth. See CANADA, HISTORY OF (Progress and Independence).

A governor general is often a citizen of the country or colony he governs. He is sometimes selected by the people in the colony, and sometimes by the government of the mother country. Governors general often work with councils or legislatures elected by the people. Under the more centralized French system, governors and governors general have extensive powers. Under the constitution of the Fifth Republic, adopted in 1958, the positions of governors and governors general were modified in most French possessions.

Governors general of Portuguese colonies still rule in absolute fashion. They are the last holdovers of classical colonialism.

ROBERT G. NEUMANN



Fairchild Aerial Surveys, Inc.

Governors Island Lies in New York Bay.

GOVERNORS ISLAND lies in Upper New York Bay at the entrance to the East River. The 173-acre island houses Fort Jay, a First United States Army post (see FORT JAY). In 1637, Wouter van Twiller, the first Dutch governor of New York, bought the island from two Indians. Later, wave erosion wore the island's 170 acres down to less than 70. In 1800, New York state ceded the island to the U.S. government. By 1912, the government had added over 100 acres to the island. Since the early 1800's, Governors Island has been used entirely for military purposes.

WILLIAM E. YOUNG

GOVIND SINGH. See SIKHS.

GOWER, JOHN. See ENGLISH LITERATURE (The Age of Chaucer).

GOYA, GO yah, FRANCISCO (1746-1828), was the most important Spanish painter of his time. He lived in Spain during an era of futile wars, corrupt aristocracy, and decadence in art, but his genius brightened a dying culture.

Goya was born FRANCISCO JOSÉ DE GOYA Y LUCIENTES in Saragossa. As a young man, he went to Madrid and studied with a conventional painter. He then went to work at the royal tapestry factory, where he came to the notice of the king. After making some church decorations, Goya received his first portrait commission. Although both Italian and French painters influenced him, his own honesty of vision asserted itself, and he began to paint as he himself saw and felt. In 1786, he was named court painter and won new prosperity, but he never compromised his art. He painted his royal subjects with brutal truth. His paintings *The Family of Charles IV*, *Marquesa De Pontejos*, and *Don Manuel Osorio de Zúñiga*, one of the most delightful portraits of a small boy, date from this period. Goya suffered a physical breakdown at this time, which left him deaf.

In the early 1800's, Spain fought in the Napoleonic Wars. Goya saw the cruel repression of the Spanish people and their brave resistance to the French conquerors. His two great paintings, *The Second of May* and *The Shooting*, sometimes called *The Execution of the Madrileños*, were inspired by these terrible episodes. Already a master of etching, Goya now began his superb paintings of social protest. These works depicted

man's inhumanity to man, and established Goya as a great artist. His painting *The Shooting* appears in color in the PAINTING article.

Disgusted with life in Spain under the harsh rule of King Ferdinand VII, Goya went to Paris, where he was received with respect. He then moved to Bordeaux, and lived there with other Spanish exiles who had left their homes to avoid oppression.

EDWARD S. SHORTER

GOYEN, *KOH ee yun*, **JAN VAN** (1596-1656), was a Dutch artist who specialized in painting landscapes. His paintings portrayed views of towns and hamlets near canals or rivers. His pictures have great depth and are full of interesting details. He was one of the first painters to stress the beauty of a large expanse of sky above a low horizon. Among his pictures is the magnificent *View of Rhenen*. Goyen was born in Leiden. After 1635, he lived in The Hague.

JULIUS S. HELD

GOZO. See MALTA.



Brown Bros.; Historical Pictures

Francisco Goya, right, painted a brilliant series of portraits during his lifetime. Don Manuel Osorio de Zúñiga, above, shows his great love and understanding of children. Goya painted the young aristocrat with much more tenderness than he usually gave to his portraits of the rich.



GRACE

GRACCHUS, *GRACK us*, was the name of a distinguished Roman family.

Tiberius Sempronius Gracchus (210?-151 B.C.?), a Roman government official, served as a general in Spain and Sardinia.

Tiberius Sempronius Gracchus (163-133 B.C.), a son of Tiberius Sempronius Gracchus the elder, was a Roman politician. Appointed magistrate, or *quaestor*, in Spain in 137 B.C., he served there during the Numantine War. In 133 B.C., he was elected *tribune*, or leader of the people. He tried to introduce land reforms to divide property more evenly and to improve the conditions of the poor. When his term of office ended, he sought re-election as tribune, which was against the Roman custom in such cases. He was killed in the disturbances that followed.

Gaius Sempronius Gracchus (153-121 B.C.) was a brother of Tiberius Sempronius Gracchus the younger. He was a statesman and *quaestor* in Sardinia in 126 B.C. Later, he was elected tribune of the people. He put back in effect the laws his brother had made, and tried to turn Rome into a democracy. Like his brother, he wanted to encourage small farms, and tried to limit the amount of land one man could own. He was re-elected tribune in 122 B.C. and became the real head of the government.

He paid no attention to the Senate, but relied on the people for his authority. When he failed to win the office the third time, there were riots, during which Gaius was killed. Gaius and his brother Tiberius were known as *The Gracchi*.

THOMAS A. BRADY

See also *QUAESTOR*; *TRIBUNES*.

GRACE is a title of courtesy for an Archbishop or Duke.

GRACE is a prayer or blessing said at a meal to give thanks to the Lord. The word *grace* comes from the Latin word *gratiae*, which means *thanks*. *Grace* is an ancient custom practiced by many religious groups. Jesus said *grace* when He distributed the loaves and fishes near Bethsaida (Mark 6: 41). He also said it at the Last Supper (Mark 14: 22).

In many religions, various forms of *grace* may be said. Many Protestant families recite the blessing "O Lord, bless this food to our use, and us to Thy service." Another popular form is "For what we are about to receive, O Lord, make us truly grateful." Children often say the blessing:

"God is great, God is good,
And we thank Him for our food."

Many Roman Catholics say the following blessing before eating a meal:

"Bless us O Lord, and these Thy gifts, which we are about to receive from Thy bounty, through Christ Our Lord. Amen."

After meals they often say:

"We return Thee thanks, O Mighty God, for these and all Thy gifts which we have received through Thy bounty, through Christ Our Lord. Amen."

In Jewish homes, a short blessing is said before meals. It is "Blessed be Thou, O Lord Our God, King of the Universe, Who bringeth forth bread from the earth." After meals, many Jewish families chant a long *grace* made up of four benedictions.

GRACE, EUGENE GIFFORD

GRACE, EUGENE GIFFORD (1876-1960), an American engineer, served as president of Bethlehem Steel Corporation from 1913 to 1957. He rose to that position just 14 years after graduating from Lehigh University. Grace started at Bethlehem in 1899 as a 15-cent-an-hour crane operator. Three years later, he became superintendent of yards and transportation. Grace was born in Goshen, N.J.

HAROLD F. WILLIAMSON

GRACELAND COLLEGE is a coeducational college at Lamoni, Iowa. It is operated by the Reorganized Church of Jesus Christ of Latter Day Saints. Courses in the liberal arts lead to bachelor's degrees. The college was founded in 1895. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GRACES were the three daughters of Zeus and Eurynome in Greek mythology. Their names were Euphrosyne (joy), Thalia (bloom), and Aglaia (brilliance). They were the goddesses of the talents of music and the arts. Aphrodite liked these gentle maidens to be her companions. Young men took their oath of loyalty by the Three Graces.

Homer in the *Odyssey* describes them as lovely young spirits of beauty. They are represented in art as embracing

The Three Graces were the goddesses in Greek legend who added beauty and grace to the lives of men.

Detail from Sandro Botticelli's *Primavera*. Uffizi Gallery, Florence, Italy.



ing each other or holding hands, and clothed in flowing white garments. The three graces stand in the foreground in Sandro Botticelli's painting *Primavera*, which appears in color in the **PAINTING** article. PADRAIC COLUM

GRACKLE, GRACK 'l, is the name of several kinds of blackbirds which live in North America. The best-known is the *purple grackle*, or *crow blackbird*. It is a



S. A. Grimes

The Handsome Purple Grackle Has Violet-Blue Feathers.

handsome bird more than a foot long, and is found in the North Atlantic states, east of the Alleghenies.

The *bronzed grackle* lives in central and southeastern Canada, and the Midwestern States. In the summer it flies north as far as Labrador. It spends the winter in the lower Mississippi Valley. It is black all over, although the male has tints of purple and blue-green about his neck, and bronze on his back. The *Florida grackle* lives in the Southern states.

Grackles live together in flocks all the year. At nesting time they separate into smaller groups and make colonies of nests in trees. They build thick, bulky nests made of mud and grass. The female lays from three to six eggs during the nesting season. The eggs are greenish or brownish in color, with dark spots.

Grackles walk with a peculiar strut. In flight, they fold their tail feathers upward and use the tail to steer.

Scientific Classification. Grackles belong to the family *Icteridae*. The purple grackle is genus *Quiscalus*, species *quiscula*, subspecies *stonei*. The bronzed grackle is *Q. quiscula versicolor*. The Florida grackle is classified as *Q. quiscula quiscula*.

ARTHUR A. ALLEN and LEON A. HAUSMAN

See also **BLACKBIRD**; **TROUPIAL**.

GRADE. See **RAILROAD** (Grades and Curves); **ROADS AND HIGHWAYS** (Grading).

GRADING is a method used in schools to record student achievement. Almost every school keeps a record of each pupil's achievement in order to have some basis for measuring his progress. The record supplies information for reports to parents. It assures the pupil of credit for the completion of courses. Universities and colleges often use *transcripts*, or copies of grades, to help determine whether they should admit a student. Transcripts are also required by some employers.

For a long time, the most common method of recording achievement was by percentage, with a mark, or grade, of 100 per cent representing perfect achievement. The minimum mark for a passing grade was usually 70 per cent, and for average work, about 80 per cent. Today, the letters A, B, C, D, E, and occasionally F, are much more commonly used. The mark of A stands for exceptional achievement, and E or F means failure. There are many other systems of marking and grading.

The difficulty of using any system of marking is that

no standards can be set by which achievement can be accurately measured. The marks assigned to a pupil represent each teacher's individual standards of comparison. Therefore, marks at best can serve only as an approximate index to achievement, and at times they can be entirely misleading.

Many factors enter into achievement besides the progress made in study. Schools often supplement marks for studies with marks for such qualities as effort, study habits, and deportment. Such marks are usually intended to indicate to parents possible reasons for high or low marks in studies. Some schools have abandoned the usual marking systems and use the marks of S for Satisfactory and U for Unsatisfactory.

A few schools use no marking system at all. Instead, each teacher writes detailed letters to the parents. Such letters report the pupil's progress, attitude, activities, and social adjustment. Sometimes ways are suggested in which the parents can assist the child. But these letters can be of real help only when the teacher is well trained to observe and interpret the child's behavior. Close observation can be carried on only in very small classes. The system of writing letters cannot be satisfactorily substituted for the report card in schools that must have large classes.

Other schools have a conference system. Parents visit the school to discuss their children's progress with the teachers. Some schools use a combination of report cards with letter grades, written reports, and teacher-parent conferences.

ALAN GRIFFIN

See also TESTS AND MEASUREMENTS.

GRADING OF GOODS. See CONSUMER EDUCATION (Grading).

GRADUATE SCHOOL is a branch of a university that offers courses for students who have already earned bachelor's degrees. Most graduate-school students work for master's and doctor's degrees in the arts and sciences. At most universities, the graduate school does not give professional training in such fields as law, medicine, and dentistry. Graduate schools usually serve as centers of research and to train college teachers. Graduate schools developed in the 1800's. See also UNIVERSITIES AND COLLEGES.

GRADUATION. Schools and colleges usually give a diploma or certificate in recognition of achievement to students who satisfactorily complete a regular course. Most institutions present their diplomas at special ceremonies, called graduation exercises.

Graduation exercises were first held by European universities of the Middle Ages. American educational institutions still have many of the European graduation customs. Usually there are two special graduation ceremonies—baccalaureate and commencement. The *baccalaureate* service is a religious service, usually held on the Sunday before commencement. The diplomas are given out in the *commencement* exercise.

In most colleges, graduates wear academic gowns and caps to the graduation ceremonies. The gowns are long and black. The tasseled, flat black caps are called *mortarboards*. Both cap and gown are patterned after European academic dress. The color of the tassel shows the kind of degree the graduate is receiving. Graduates may wear colored hoods on their backs to show the highest degree they already hold, and the institution which conferred it.

GRAFTING

It is a custom at many high schools and some colleges for the valedictorian and salutatorian of the graduating class to make farewell speeches to their school. The *valedictorian* is the graduate with the highest marks, and the *salutatorian* is a graduate with the second highest marks.

Many schools also have other ceremonies connected with graduation. At such meetings, the graduating class may read the "class will" and the "class prophecy." It may make a gift to the school.

R. FREEMAN BUTTS

See also BACCALAUREATE; CAPS AND GOWNS; DEGREE, COLLEGE.

GRADY, HENRY WOODFIN (1850-1889), was a journalist and orator of the southern United States. He edited the Atlanta (Ga.) *Constitution* from 1879 until his death. Through his editorials and his many speeches, he helped promote the rebuilding of the South after the Civil War. He delivered one of his most famous speeches, "The New South," in New York City in 1886. His works, published after his death, include *The New South and Other Addresses* (1904) and *Complete Orations and Speeches* (1910). Grady was born in Athens, Ga., and attended the University of Georgia.

I. W. COLE

GRAEAE. See PERSEUS.

GRAF, URS (1485?-1529), a Swiss printmaker and professional soldier, became known for his woodcuts and etchings. His print *Woman Bathing Her Feet*, published in 1513, is the earliest-known print bearing a date. His most famous print is *Man-at-Arms and Death*, which has great dramatic power and is typical of the soldier's world that Graf knew so well. He led a turbulent life.

S. W. HAYTER

GRAF SPEE, grafh shpay, was one of three German *pocket battleships* (swift, heavily armed cruisers) which preyed on British merchant ships in the Atlantic Ocean early in World War II. In 1939, after a battle with three smaller British ships, the Graf Spee was cornered in the neutral port of Montevideo, Uruguay. Adolf Hitler ordered it scuttled. The ship was named *Admiral Graf Spee* after the German commander in the World War I battle of Jutland.

GRAF ZEPPELIN. See AIRSHIP (German Airships).

GRAFT in American politics refers to the acquisition of money or position through dishonest means. The word probably comes from the idea that such profit is something added to, or *grafted* onto, legitimate political enterprise. Common examples of graft include the acceptance of money by an officeholder for certain political favors, and the placing of unqualified relatives and friends on the government payroll to repay their support in a political campaign. Corrupt big-city parties, commonly called *machines*, are usually associated with graft on a large scale.

MURRAY S. STEDMAN, JR.

GRAFTING is the application of skin to an area of the body from which skin has been lost. The surgeon normally uses skin from the injured person himself for the graft. Sometimes the surgeon cuts off a small area from the skin of another part of the body, such as the arm, and places it over the injured area. New skin then grows over the area and covers it. Or, the surgeon may cut thin pieces of skin from any part of the body with a special instrument. He places these pieces on the injured area, and they grow to cover the wound. See also PLASTIC SURGERY.

W. B. YOUMANS

GRAFTING

GRAFTING. A graft is the union of parts of two plants to make a single plant. Grafting sometimes occurs naturally when two plants come in contact. Frequently, man grafts plants. He joins a cutting from one plant to a root, or to a stem bearing roots, of another plant. The part implanted is called the *cion*. The plant receiving the cion is the *stock*. The cion retains the characteristics of the plant from which it is taken. The stock supplies food and water for the growing plant.

Uses of Grafting

The main uses of grafting are to multiply plants which do not come true from seed. Grafting often saves time in growing plants, as when one-year-old cions are grafted on two-year-old roots.

Grafting is also used to change the habit of growth. For example, trees can be dwarfed by grafting cions of vigorous plants on less vigorous stocks. Sometimes plants that do not thrive on a soil are grafted on stock that grows well on that particular soil. The time of bearing of a fruit tree, for example, both in years and season, may be changed by grafting.

Several varieties of any plant may be grafted on one stock. In this way, by grafting branches from several different kinds of apples on a single stock, the trees may grow as many as five different kinds. Plants susceptible to injury by certain insects may be grafted on stocks which resist these insects. Damaged plants may be repaired by grafting.

Commonly, only hard-wooded plants are grafted. This includes all fruit trees, nut trees, and some lawn trees such as magnolias. Currants and the bramble fruits can be grafted but seldom are. Grapes and roses are often grafted. Many soft-wooded plants may also be grafted. The tomato and potato are easily intergrafted. Dahlias, peonies, cacti, and various other soft-wooded flowers may be grafted each within its kind. Only closely related plants can be grafted on each other. Apples are not grafted on pears, but both the apple and pear may be grafted on quince roots. Plums may be grafted on peaches, but not on apples or pears.

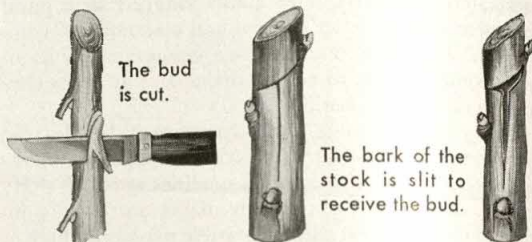
Kinds of Grafting

There are three kinds of grafting, each with many methods. They are (1) cion grafting, (2) budding or bud grafting, and (3) inarching. In all, the cambium layer of stock and cion must come in close contact. The *cambium* is the soft formative tissue between wood and bark. In the spring, the cambium is active as a soft butterlike covering of the woody cylinder. Therefore the spring is the time for cion grafting and inarching. Budding must wait until midsummer when buds are well formed and bark still slips readily.

Cion Grafting. In this method, cions are taken from dormant wood at any time between the fall of leaves and spring. If cut more than a few days before grafting, the cions are packed in moist sand and kept in a cold place. Cions must have one bud, or better, two. Most commonly, cions are inserted in the root, crown or stem of the stock. The chief ways of insertion are whip grafting and cleft grafting.

Whip Grafting is most used when the stock is a root. This has long been the favorite method of propagating

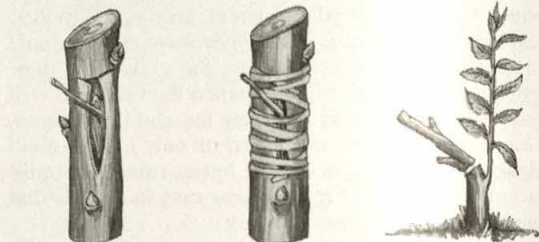
BUD GRAFTING



The bud is inserted in slit made in the bark of the stock.

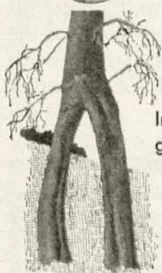
The bud is tied in place with waxed yarn.

The top of the stock is cut off after the bud grows.



INARCHING

In a natural inarched graft, two trees have grown together along the bark of their trunks.



After two plants have been inarched, the root and lower stem of one will be cut away.



apples and pears. The rootstocks are one or two years old. They are dug in the fall and stored until late winter when grafting begins. Stock and cion are 6 or 8 inches long. The stock is the longer, and its diameter is about that of a lead pencil. Both stock and cion are cut diagonally with a smooth cut $1\frac{1}{2}$ inches long. A vertical cleft is then made in both root and cion, so that they can fit closely. The tongue of the cion is pushed into the cleft of the stock. The joint is tightly wrapped with waxed yarn made by soaking a ball of yarn in hot grafting wax. The grafts are then tied in bundles and stored, as were the cions, until planting time in the spring. The grafts must be kept cool, but not allowed to freeze.

Cleft Grafting is used in grafting old trees. A branch 1 to 2 inches in diameter is cut off squarely. It is then split and a cion with a wedge-shaped butt is inserted into the cleft. The cleft is closed around the cion and covered with grafting wax. But soft wooded plants are not covered with wax. Instead, they are wrapped carefully with waxed yarn.

Budding. In budding, a single bud is grafted on the stock. Fruit trees, roses, and many ornamental plants

WHIP GRAFTING



The cion is cut slant-wise, with an extra notch in the cut side.



The cion is fitted over the stock and tied in place.



A whip-grafted cion grows well from a rooted stock.

CLEFT GRAFTING

The sawed-off end of the stock is slit with a grafting chisel.



The cion is cut with a wedge-shaped end and inserted in the slit top of the stock.



A year after the graft is made, the stock and cions would look something like this if split.

Cross-Grafting the Limbs of two elders into rungs created this "living ladder," which can support a man's weight. Twisting and grafting trees into such fantastic forms takes up to 10 years.

Robert Lackenbach, *Life* © 1957 Time, Inc.

are propagated by budding. The cion in this case is a mature bud cut from a twig of the current year's growth with a bit of bark and a bit of wood. The bud is inserted in a T-shaped wound in the stock by pushing it down, using the leafstalk as a handle. When the bud has begun to grow, the top of the stock is cut away close to the graft. The waxed yarn should be removed as soon as the graft begins to grow, to avoid strangling the plant.

Inarching is a process of grafting two plants, each of which is on its own roots. To graft by inarching, one removes a small area of bark on each plant and ties the stock and the cion together. When the union is complete, the lower part of the cion is cut away. Two kinds of inarching are shown in the illustration on page 290.

Other Methods. *Bark grafting* is a way of repairing large trees. The bark is opened and the cion is pushed down between the bark and the wood. The cions are cut thin, held in place by a waxed bandage, and covered with grafting wax. In *splice grafting*, cion and stock are cut across diagonally, laid together, and kept in place by tying with waxed string. *Annual budding* is used in grafting trees with thick bark.

HENRY T. NORTEN





United Press Int.

Evangelist Billy Graham has preached before millions of people on his spiritual crusades to all parts of the world.

GRAHAM, "BILLY," WILLIAM FRANKLIN (1918-), is a leading American evangelist. His work in the United States and England for the "Youth for Christ Crusade" led him and his colleagues to conduct a large-scale evangelistic campaign in Los Angeles in 1949. The success of his effort influenced him to engage solely in large-scale evangelism. He conducted extended campaigns in England, Scotland, and the United States, and briefer campaigns in Europe and the Far East. Graham started a radio program, "The Hour of Decision," in 1950, and also appeared frequently on television. He made several religious films and wrote *Peace with God* (1954) and *Secret of Happiness* (1955).

Graham was born near Charlotte, N.C. He was graduated from Wheaton (Ill.) College. He was ordained to the ministry in 1940.

L. J. TRINTERUD

GRAHAM, MARTHA (1902?-), is an American dancer and choreographer. She became the leading performer of an American movement in contemporary dance called *modern dance* (see DANCING [Modern Dance]). She gave her first solo concert in New York in 1926. She formed her own company in 1929, and also established the Martha Graham School of Contemporary Dance. She was the first dancer to receive a Guggenheim Fellowship (1932). Miss Graham was born in Pittsburgh, Pa.

DORATHY BOCK PIERRE

GRAHAM, THOMAS. See COLLOID.

GRAHAME, KENNETH (1859-1932), a Scottish author, wrote *The Wind in the Willows* (1908), a children's classic. The story tells the adventures of Toad, Rat, Mole, Badger, and other small animals in the woods, rivers, and fields of England. Grahame started the tale as a series of letters to his little son Alastair, who was known as "Mouse."

Grahame's first book was *Pagan Papers* (1893). He also wrote *The Golden Age* (1895), containing studies of childhood which were read throughout the English-speaking world. In 1898, he published *Dream Days*, a sequel to *The Golden Age*, which included the tale of "The Reluctant Dragon."

Grahame was born in Edinburgh, and was educated in England. He joined the staff of the Bank of England, and became its secretary.

JEAN THOMSON

GRAIL, HOLY. See HOLY GRAIL.

GRAIN is the smallest unit in the avoirdupois system of weights. It equals $\frac{1}{7000}$ of a pound. Its value is

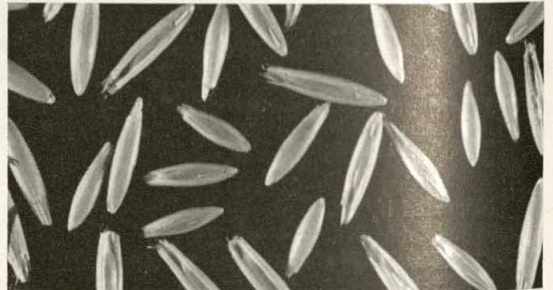
believed to have been based on the weight of an average grain of wheat. The grain equals .0648 grams. The name grain is also used for one fourth of a carat. See also APOTHECARIES' WEIGHT; AVOIRDUPOIS; WEIGHTS AND MEASURES.

E. G. STRAUS

GRAIN is the dried and threshed "seeds" of grasses. The plants on which they grow are also called grains. The *cereal* grains are grasses whose seeds can be used for food. For example, the seed of the wheat plant can be ground into flour. But a few plants that are not grasses also produce fruits similar to the true cereal grains. Among these is buckwheat, which is related to rhubarb (see BUCKWHEAT).

Kinds. The most important cereal grains are rice, wheat, and corn. Next in order of importance are oats, barley, and rye. Other crops grown for their edible seeds do not rank in importance with the "big six." Grain sorghum, which comes from a grass resembling corn, is grown in large quantity, but the grain is used mostly to feed livestock. Millets produce several kinds of inferior small grains used as food. Foxtail millet, proso millet, and pearl millet are a few of these. In South America, a plant related to lamb's-quarters, a North American weed, produces a grain called *quinoa*. Wild rice, the grain of an American water grass, is harvested by the Indians as food.

Uses. Grains are used as food and as raw materials in manufacturing. Where meat is scarce or expensive, people live mostly on cereal grains. Some cereals, such as wheat and rye, contain a sticky protein called *gluten*. Flour made from these grains can be used for bread. Flour from other cereals does not make good bread. But it can be used for pastries, meal, and breakfast cereals. Hominy and grits are made from corn treated with lye



Grains of Oats Grow in Pairs. In each pair, one grain is large and the other small. Oats are very nourishing, and grow best in clay or loam soil where the weather is moist and cool.



Wheat Is the Most Valued of All the Cereal Grains. No other grain except rice feeds so many persons. Wheat flour makes the kind of bread people in the Western world prefer.

to remove the hull. Manufacturers prepare starch from corn, wheat, or other grains. Makers of corn products prepare corn sirup by treating corn starch with acid.

Any of the cereal grains can be used as animal feed. In the United States, farmers use much of the corn and most of the sorghum they grow for forage. Farmers also use the by-products of grain refining to feed their stock. For example, bran, polishings, and germ make excellent forage. Manufacturers use grain to make malt and in the fermentation of beer and liquors. Drug manufacturers use grains for culture mediums for yeasts, fungi, and bacteria that produce vitamins and antibiotics.

History. Man has used the cereal grains as a source of food for thousands of years. Wheat, maize, and rice were grown by primitive man long before recorded history. Therefore, the original wild forms of these plants are unknown and scientists do not know where they originated. However, they do know that maize is native to the Western Hemisphere. Indians cultivated maize long before Columbus discovered America. The early American explorers then introduced this grain into Europe. Wheat, oats, barley, and rye were brought to America by colonists early in the 1600's. RICHARD W. POHL

Related Articles in WORLD BOOK include:

KINDS OF GRAIN

Barley	Grain Sorghum	Oats	Rye
Corn	Millet	Rice	Wheat
Emmer			

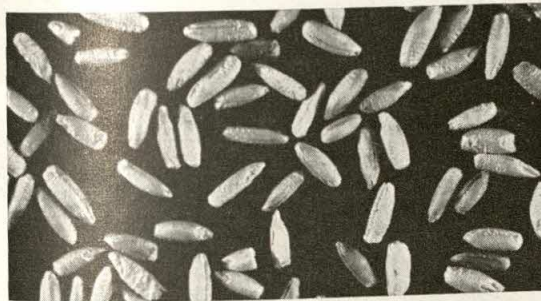
UNCLASSIFIED

Board of Trade	Combine	Grass
Bread	Gleaning	Grits
Breakfast Cereal	Grain Elevator	Hominy
Carbohydrate	Grain Weevil	



Burlington Railroad

Huge Concrete Grain Elevators line the railroad tracks in Omaha, Nebr. Grain is elevated from the railroad cars to the cupola to be cleaned and weighed before it goes to the storage bins.



Grains of Rye can be ground into flour for use in making bread, or they may be fermented for making distilled alcoholic drinks. Rye is a very hardy plant.

GRAIN ELEVATOR is a tall building equipped with machinery for loading, unloading, cleaning, mixing, and storing grain. These buildings are familiar sights in farm areas and in ports where grain is stored before shipment. The term *grain elevator* is also used to mean the machine that lifts grain from a train or a ship to the storage bins. Some of these machines consist of systems of buckets that can unload the largest grain-carrying ships in a matter of hours.

Kinds of Grain Elevators. There are two general types of grain elevators—country elevators and terminal elevators.

Country Elevators are found in nearly every town in grain-producing areas. These smaller elevators receive grain from farmers and store it for short periods of time. The grain is cleaned and conditioned in them, and then graded before it is shipped to the large markets in railroad cars. Country elevators generally hold from 25,000 to 30,000 bushels of grain. They may be owned by independent businessmen, by farm cooperatives, or by grain companies.

Terminal Elevators stand at large grain markets and shipping centers such as Chicago, Minneapolis, and Port Arthur, Ont. In these elevators, grain is stored for the use of millers or to await shipment on the Great Lakes or overseas. Terminal elevators are larger than country elevators. Several hold more than a million



Frank Cassidy

Whole Grains of Barley are used for thickening soups and in foods for babies and invalids. Barley is ground into flour to make the black bread eaten by European farmers.

GRAIN FUTURES ADMINISTRATION

bushels of grain. One elevator at Enid, Okla., has a storage capacity of 16,000,000 bushels.

How Grain Elevators Operate. Grain elevators were once made of wood. But today they are often made of concrete. They usually stand more than 100 feet high. Weighing and cleaning take place in the top stories, above the storage bins. This area is called the *cupola*.

Railroad cars are unloaded at grain elevators by shoveling, or by means of devices that tip a boxcar so that the grain runs out of the doors. Elevators for loading and unloading ships have *marine legs* on the dock side. To unload a vessel, the hatches are first removed, and the legs lowered into the holds. Electrically operated buckets in the legs quickly raise the grain to the top of the cupola. From there, the grain goes through a *scale hopper* that weighs it, and then through a cleaner to the storage bins. Large terminal elevators can unload about 10,000 bushels of grain per leg each hour. A huge elevator at Superior, Wis., said to be the world's largest, can unload the largest grain-carrying ship in less than four hours.

JOHN H. FREDERICK

See also CANADA (color picture, Golden Harvests from Western Canada); MINNESOTA (color picture, Elevators at Duluth).

GRAIN FUTURES ADMINISTRATION. See COMMODITY EXCHANGE AUTHORITY.

GRAIN SORGHUM is a cereal-food plant extensively used for forage. But in Africa and Asia it is also sometimes used for flour and for breakfast foods. Sorghums are native to Africa, but were introduced into the United States during the late 1800's. They are grown chiefly in the arid regions of the southern Great Plains states, in Arizona, and in California. The plants resist heat and drought. They bear small, round, starchy seeds in compact masses on a single stalk. Six kinds of grain sorghum are grown in the United States: durra, feterita, kafir, milo, kaoliang, and shallu.

Scientific Classification. Grain sorghum belongs to the grass family, *Gramineae*. It is genus *Sorghum*, species *vulgare*.

LOUIS PYNSEN

See also SORGHUM; KAFIR.

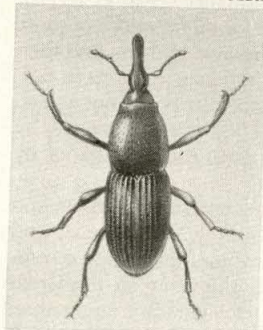
GRAIN WEEVIL, *WEE v'l*, is a small, dark beetle that infests grain stored in granaries, warehouses, and grain elevators. The *granary weevil*, which infests granaries, and the *rice weevil* are the best known of these insect pests.

The weevils are about $\frac{1}{8}$ of an inch long, including a long snout that extends from the head. The granary weevil has no wings, but the rice weevil's wings are well developed.

The rice weevil is especially destructive to the rice crops of the United States. It also feeds on other grain. The female beetle punctures the grain with her sharp snout, and lays an egg in the hole. The egg hatches into a tiny white grub without feet. This grub eats into the grain. Within about 41 days, an egg produces a full-grown beetle.

The Granary Weevil

USDA



If eggs are laid in grain while it is still in the field, they will produce beetles in the granary or mill. These beetles, in turn, increase rapidly, especially in dark places. Rice weevils lay eggs in standing grain and in the shocks. See WEEVIL (picture, The Rice Weevil).

Whenever storage places have become infested, they must be thoroughly cleaned before new harvests are stored. Infested grain should be fumigated with a suitable poisonous gas.

Scientific Classification. Grain weevils belong to the weevil or snout beetle family, *Curculionidae*. The rice weevil is genus *Sitophilus*, species *oryza*. The granary weevil is *S. granarius*.

R. E. BLACKWELDER

GRAINGER, PERCY ALDRIDGE (1882-1961), an Australian-born pianist and composer, became a leading interpreter of Edvard Grieg's piano music. The Norwegian composer also inspired Grainger to collect folk songs and dances of England (see GRIEG, EDVARD). Grainger's works include "Molly on the Shore" for string quartet; "Irish Dances," tunes from English, Scottish, and Irish sources for unaccompanied chorus; and "Green Bushes" for orchestra. His choral works include "Marching Song of Democracy" (1917) and "Tribute to Foster" (1930).



Culver

Percy Aldridge Grainger

Grainger was born in Melbourne, Australia. He first studied piano with his mother, and then went to Germany to study with Ferruccio Busoni. He settled in the United States in 1914.

JOYCE MICHELL

GRAM is the unit of weight and mass in the metric system. A kilogram is 1,000 grams. One gram equals slightly more than 15.432 grains, or almost .0353 avoirdupois ounces. One avoirdupois ounce equals almost 28.35 grams. As a unit of mass, the gram equals the mass of a cubic centimeter of water at 39.2°F., or 4°C. It weighs slightly more than .0022 pounds. The gram is used to weigh light articles, especially drugs and medicines.

E. G. STRAUS

See also CARAT; METRIC SYSTEM.

GRAMBLING COLLEGE is a state-controlled, co-educational teachers college at Grambling, La. It grants B.S. degrees in elementary and secondary education. Grambling was founded in 1901. For enrollment, see UNIVERSITIES AND COLLEGES (table).

GRAMICIDIN, *GRAM ih SYE din*, is a drug used to kill several kinds of disease-producing bacteria. It is effective against such bacteria as the pneumococcus, staphylococcus, and streptococcus. Gramicidin cannot be injected into the body, but it can be applied locally. Doctors have found it useful in healing skin ulcers and in treating pleurisy, sinus infections, and other ailments. René Dubos, a French-born scientist engaged in research at Rockefeller Institute in New York, discovered gramicidin in 1939. Through careful research work, Dubos learned that certain "germ-killing" substances were produced by bacteria living in soil. Gramicidin is now made from strains of soil bacteria that were developed by Dubos.

RENÉ DUBOS

GRAMMAR is a set of language principles that people follow in order to make themselves understood. A language communicates in at least two ways. First, it uses words with meanings. Words have become symbols for certain ideas, and users of a language generally agree about the meaning of a word. Users of English, for example, agree to associate the word *wolf* with a certain doglike carnivorous mammal. Users of French agree on a different symbol, *loup*, for the same object. Language also communicates in a second way, by putting words together to show how ideas are related. A word like *wolf* almost never appears by itself. It is related to other words as part of a sentence and often as part of a paragraph. Grammar is a description of this second way in which language communicates. It is a body of statements that describe how words work together in sentences.

Neither of the two ways of communicating will work without the other. Consider the following group of words arranged in alphabetical order:

Had lady old swallowed the the wolf.

The meaning of each word is clear, but the words do not make sense as a group because we do not know how they are related to each other. If the words are rearranged so that we can tell how they are related—can tell who does the swallowing and who gets swallowed—the sense of this group of words becomes clear.

The wolf had swallowed the old lady.

Or consider another group of words:

The wonk had mipped the frib wittock.

This makes no sense, because some of the words are merely nonsense syllables. But we can understand something about how the words are related to each other.

We know that the *wonk*, whatever it may be, acted as a subject and did the *mipping*, whatever that may be. We also know that the *frib wittock*, whatever it may be, acted as an object of the “verb,” *mipped*. Although the nonsense syllables do not mean anything, we can understand their relationships in terms of grammar.

The Study of Grammar

A child of four or five actually knows and uses many fundamental principles of grammar. As he learns to speak, he becomes familiar with the basic patterns of sentences. He learns what words mean, and how to put them together. But as he grows older and develops more complicated ideas, he needs more accurate ways of expressing them.

The study of grammar examines how a language works. Therefore, knowledge of grammar helps children and adults improve their speaking, writing, and thinking skills. Like the study of chemistry, physics, or any other science, it reveals important facts. It provides insight into one of the most significant single tools that man has evolved, language. This is one of the characteristics that distinguish man from animals. Man has used it to raise the level of civilization. The study of English grammar is also fascinating, because the grammar describes a language with an interesting history. English is constantly changing and growing, and has proved versatile and subtle in its development.

Signals of Grammar

A language provides two kinds of signals, those of

Ewing Galloway

Grammar is an important topic in the curriculum of elementary schools. More emphasis is placed on correct usage of words than on memorization of rules. Some teachers use the technique of writing correct and incorrect sentences on chalkboards. Then they help the children select the grammatically correct sentences. The incorrect sentences are crossed out to show that they are not considered good English.



GRAMMAR

meaning and those of grammar, to guide the individual to his goal of effective communication. The signals of meaning are words, whose current definitions are found in dictionaries. The signals of grammar differ in various languages.

Inflections, or changes in the form of words, may reveal grammatical relationships. Several languages, including Latin and German, change word endings to indicate how words are related to each other in a sentence. Modern English also uses endings as signals of grammar, but they are less significant than other devices. Only a few endings remain in the language: *-s* or *-es* to show plurals; *-s* to show possession; *-ed*, *-en*, *-ing*, and *-s* endings and some other form changes in verbs; *-ly*, *-er*, and *-est* endings on modifiers; and the changes in the form of pronouns. See INFLECTION.

English uses mainly word order and function words to convey grammatical ideas.

Word Order is the most important signal of grammar in English. The following English sentences, both containing exactly the same words, show the importance of word order:

The farmer loves the girl.

The girl loves the farmer.

In *The farmer loves the girl*, we know who does the loving because the word is located at the beginning of the sentence, in the subject position. To change the meaning, we change the order: *The girl loves the farmer*. In the same way, word order reveals the grammar of a more complicated sentence:

The farmer with the gold tooth loves the girl who lives in the big house.

Word order shows not only which word is the subject but also which words modify the meanings of the other words, making them more specific. Changing the word order in a sentence with modifiers changes meaning in a number of ways. For example, if we interchange the subject and object of the above sentence we find that the girl now has the gold tooth, and that the farmer lives in the big house.

The girl with the gold tooth loves the farmer who lives in the big house.

Function Words are another important signal of grammar in English. Many words in the language do not mean anything specific. But they show something about the use or meaning of other words. In *The farmer has broken his plow*, *has* does not mean *possess*. But it does tell us something about the meaning and use of *broken*. It is a signal of grammar. Dozens of other words, such as *must*, *can*, *of*, *for*, *since*, *because*, *after*, *to*, and *more*, usually serve as function or relating words.

Grammatical Relationships

Grammatical relationships are subtle and varied. But they can be classified into three types: (1) the actor-action-goal, (2) coordination, and (3) subordination.

The Actor-Action-Goal, or *subject-verb-complement* relationship, is the basic relationship. It is sometimes called the *nexus*. This relationship is the essential part of the English sentence. It expresses the idea that somebody or something does or is somebody or something. The relationship is revealed mainly by word order, reinforced through other devices.

Coordination. Grammatical signals can show that two or more ideas should be considered equal or coordinate. Their equality can be shown by expressing the ideas in parallel form and order. Sometimes function words like *and* or *or* are used to express coordination. For example:

The farmer worked all day and finished the new fence.

Subordination, the third main relationship, indicates that one thing is dependent on another or is of lower rank. Usually subordinate elements are *modifiers*. They alter in some way the meaning of the passages to which they are subordinate. Word order and function words usually reveal subordination, as in the following:

When the farmer had finished working, he sent a bouquet of red roses to the girl.

All the sentence except the subject-verb-complement core, *he sent bouquet*, is made up of subordinate expressions. *When the farmer had finished working* modifies the main action, telling when it happened, *red* modifies *roses*, giving their color, and *of red roses* modifies *bouquet*.

Sentence Patterns

Sentence patterns are different ways of organizing sentences. The study of such relationships is called *syntax* (see SYNTAX). The following sentences are examples of common patterns for simple sentences:

The farmer smiles. The farmer loves the girl.

The farmer is a man. The farmer is foolish.

The elements of these patterns are a *subject*, which appears first (*farmer*); a *verb*, which follows the subject and tells what it does or links it to what follows (*smiles*, *loves*, *is*); and a *complement*, which completes the meaning of either the verb or the subject (*girl*, *man*, *foolish*). The complement may be an *object* (*girl*), receiving the action of the verb; or it may be a *subjective complement*, repeating the subject (*man*), or modifying it (*foolish*).

These patterns may be varied for special purposes. Reversed order may designate a question (*Is the farmer a man?*). The subject may appear after the verb in a sentence introduced by *there* or *it* (*There are no foolish farmers*). In a passive pattern, the actor may not be the subject (*The farmer was loved by the girl*).

At least one such pattern is the framework of every English sentence. A person may combine these frameworks or parts of them as coordinate or subordinate parts of other sentences to build complicated sentences. And he may expand any part of the basic pattern with modifiers. The following is a more complicated sentence, but it is merely a combination of patterns and modifiers of their parts:

The girl who lives in the big house loves the farmer with the gold tooth, but her father threw the farmer out in the street when he came to call.

Parts of Speech

Sentences are made up of five main elements—subjects, verbs, complements, modifiers, and function words. To make grammar study easier, words used in sentences are traditionally classified further into eight parts of speech. It is often difficult to analyze an English sentence in terms of the traditional parts of speech, because the classifications were originally taken over from Latin, which is quite different grammatically from English. But parts of speech can apply in general to modern

English if they are defined functionally and considered as subdivisions of the five main sentence elements. The words or word groups used as subjects and complements are *nouns* and *pronouns*. Modifiers are *adjectives* and *adverbs*. Function words include *prepositions* and *conjunctions*. The *verb* and the *interjection* usually function independently. See PARTS OF SPEECH.

Grammar and Usage

A language develops through usage. Language habits develop differently in different localities or in different professional or social groups. As a result, one way of speaking is often more appropriate to one situation than to another.

In some situations, *I ain't saw nobody here* would not seriously jar anybody's sense of propriety. It is understandable, even grammatical, in the sense that it fits descriptions of how English works. But it is not *standard* English. Standard English is the language used in serious educated speech and writing. It has the advantages of commanding universal respect and acceptance and of being universally understandable. Slang or dialect is limited, but standard English is generally appropriate.

Educated speakers and writers of English try to follow the patterns of standard English. They do not, for example, use *ain't*, even though it is a word long-established in the language. Usage has never accepted it as standard. The double negative is not current standard English, although it was standard in William Shakespeare's day and is used in French.

Grammar and usage are closely connected, because usage determines which expressions are appropriate in which grammatical situations. For example, usage restricts *like* in standard English to the grammatical function of a preposition. But expressions such as *This tastes good like a cigarette should*, are becoming so common that the custom may change. *Whom* rather than *who* is the standard form for objects, but questions like *Who did they elect?* are more and more frequent. A full understanding of grammar therefore requires attention to the usages of standard English.

ROBERT M. GORRELL

Related Articles. See the heading Grammar in the LANGUAGE section of the READING AND STUDY GUIDE. See also the following articles:

Apposition	Etymology	Punctuation
Capitalization	Language	Sentence
Clause	Parts of Speech	Syntax

GRAMOPHONE. See PHONOGRAPH.

GRAMPIAN MOUNTAINS. See SCOTLAND (Land Regions).

GRAMPUS. See KILLER WHALE.

GRAM'S METHOD, or STAIN. See BACTERIOLOGY.

GRAN CHACO, *grahn CHAH koh*, is a great, low-lying plain in South America. It covers more than 200,000 square miles west of the Paraguay and Paraná rivers. Most of the Chaco lies in northern Argentina and western Paraguay, but it also extends into southern Bolivia. More than half of the Chaco belongs to Paraguay. The boundary with Bolivia was settled in 1938 after the long and bloody Chaco War (1932-1935).

The Chaco has great swamps, thorny brush jungles, and grassy plains. Its chief rivers are the Pilcomayo and Bermejo, which flow into the Paraguay. Products include cattle, cotton, and quebracho.

HARRIS G. WARREN

See also PARAGUAY (Land Regions; Local Government; Military Ruin).

GRANADA

GRAN QUIVIRA NATIONAL MONUMENT is in central New Mexico. It contains pueblo ruins and one of the most important of the earliest Spanish mission ruins in the Southwest. The 610.94-acre monument was established in 1909.

GRANADA, *gruh NAH duh* (pop. 21,035), a port on Lake Nicaragua, is the most important commercial center in Nicaragua. For location, see NICARAGUA (color map). From Granada, merchants ship cargoes of sugar, coffee, cacao, alcohol, hides, cotton, and indigo to the Pacific Coast. Most wealthy and aristocratic Nicaraguans live in Granada. The city, the oldest in Nicaragua, was founded in 1524. William Walker burned the city in 1856, but it was soon rebuilt (see WALKER, WILLIAM). Many beautiful buildings, including the cathedral, still are standing.

ROLLIN S. ATWOOD

GRANADA, *gruh NAH duh*, was once a Moorish kingdom in southern Spain. The name may have come from the Spanish word *granada*, which means *pomegranate*, or from the Arabic word *Karnattah*, which means *Hill of Strangers*.

Granada lay on the southern coast of Spain, and had



Location Map of Granada Province, Spain. The black area is modern Granada, part of a much larger region once occupied by the old Moorish Kingdom of Granada.

an area of about 12,000 square miles. In the 700's, Moorish invaders conquered Granada and other parts of southern Spain. Granada became an independent kingdom in 1238. It remained a great center of Moslem learning and civilization after the Moorish strongholds in other parts of Spain had fallen.

The downfall of Granada came when Moorish rulers began to quarrel among themselves. The armies of Ferdinand and Isabella succeeded in gaining possession of the kingdom in 1492. In the 1800's, the region was divided into three provinces called Granada, Malaga, and Almería. Granada is now a Spanish province in Andalusia. It has an area of 4,838 square miles and a population of about 793,000. Its capital is also called Granada.

WALTER G. LANGSAM

See also BOABDIL; MOOR.

GRANADA, *gruh NAH duh* (pop. 154,589), in southeastern Spain, is the site of the Alhambra palace and fortress (see ALHAMBRA). It is also the capital of Granada province. The tombs of Ferdinand and Isabella lie in the Royal Chapel of Granada's cathedral. Granada factories produce textiles, leather, macaroni, and chocolate. For location, see SPAIN (color map).

The Moors founded Granada about A.D. 750. In the 1200's, the city served as the center of Moorish wealth and culture. In 1492, when the armies of Ferdinand and Isabella conquered Granada, it was the last Moorish stronghold in Europe.

WALTER G. LANGSAM

GRANADOS, ENRIQUE

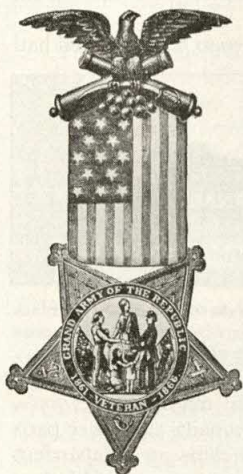
GRANADOS, *grah NAH thos*, **ENRIQUE** (1867-1916), a Spanish pianist and composer, became known for his charming piano works, *Goyescas*, inspired by the famous painter Goya. He also was noted for four volumes of *Spanish Dances*. He composed the operas *Mariá del Carmen* and *Goyescas*, which was based on the piano works. He also wrote two symphonic poems, *Dante* and *Serenata*. Granados was born in Lérida, Spain. He was educated at Barcelona, Madrid, and Paris. He opened a piano school in Barcelona.

JOYCE MICHELL

GRAND ALLIANCE was a coalition formed in 1702 by England, Holland, Austria, and the Holy Roman Empire to fight France and Spain in the War of the Spanish Succession. Portugal and several other states later joined it. The Treaty of Utrecht ended the war in 1713.

See also RYSWICK, TREATY OF.

GRAND ARMY OF THE REPUBLIC (G.A.R.) was a society of men who fought for the North in the Civil War. It was organized at Decatur, Ill., on Apr. 6, 1866.



The G.A.R. Badge was a bronze star hung on a ribbon. The star shows a soldier and sailor shaking hands in front of a figure of Liberty.

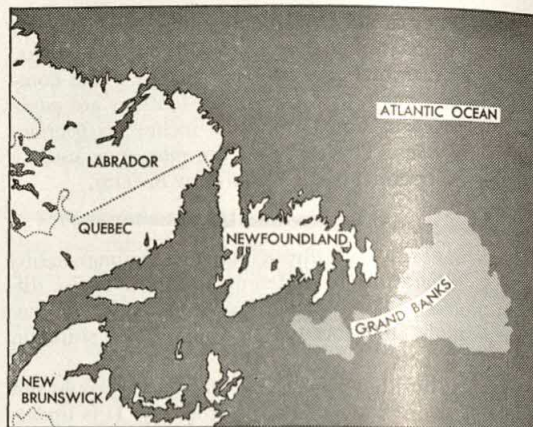
The society was founded to strengthen fellowship among men who fought to preserve the Union, to honor those killed in the war, to provide care for their dependents, and to uphold the Constitution. Membership was open to honorably discharged soldiers, sailors, or marines of the United States armed forces who served between Apr. 12, 1861, and Apr. 9, 1865. The Grand Army had 409,489 members in 1890. Its last member died in 1956.

The society founded soldiers' homes, and was active in relief work and in pension legislation. The G.A.R. started the celebration of Memorial Day in the North by a general order issued by John A. Logan. The Woman's Relief Corps began as an auxiliary to the G.A.R.

See also MEMORIAL DAY; UNKNOWN SOLDIER; WOMAN'S RELIEF CORPS, NATIONAL.

GRAND BANKS is a 500-mile stretch of shallow water off the southeast coast of Newfoundland, known as one of the best fishing grounds in the world.

The Grand Banks curve in a 200-mile arc around the Newfoundland coast, and extend as far as 300 miles out into the Atlantic Ocean. They begin about 100 miles from Cape Race at the southeastern tip of Newfoundland. The waters over the banks lie from 50 to 1,000 feet deep, and are crowded with fish. Thousands of seabirds circle over these schools of fish and guide fishermen to good catches. Cod especially are caught in large numbers. The fishermen use heavy boats to sail the shallow waters. Besides the danger of hitting rocks, the



The Grand Banks Lie Off the Coast of Newfoundland.

fishermen must brave storms, icebergs, and dense fogs. Fogs are common when air that has passed over the warm Gulf Stream flows over the cold Labrador Current near the banks.

BOSTWICK H. KETCHUM

See also FISHING INDUSTRY (Fisheries of North America).

GRAND CANAL. See CANAL; CHINA (Transportation); VENICE.

GRAND CANYON NATIONAL MONUMENT in northwestern Arizona lies between Grand Canyon National Park and Boulder Dam National Recreational Area. Torowep Point at the monument site affords an unusual view of the Inner Canyon. The 201,291-acre monument was established in 1932.

GRAND CANYON NATIONAL PARK covers 673,575 acres in northwestern Arizona. It includes 105 miles of the most colorful part of the Grand Canyon of the Colorado River. The Colorado River rushes at the bottom of the canyon, about 1,850 feet above sea level. The sides of the canyon are made of rocks, cliffs, ridges, hills, and valleys of every form. Many of the ridges have weather-carved lines which make them resemble Chinese temples. Thick forests cover the canyon rims.

The north rim of the Grand Canyon rises about 1,200 feet higher than the south rim. The highest points on the rim are about 9,000 feet above sea level. Trails in the park lead across the river from rim to rim.

The Rocks and Their Colors. The colorful canyon rocks were formed millions of years ago. Their colors change with the changing light of the sun. Many layers of rock have been bared by the constant cutting force of the rushing river. The first layer of rock through which the Colorado River now cuts is called *Archean* and is black in color. The second layer of rock, called *Algonkian*, has a brilliant red color. The next layer is a lavender-brown color. It is known as *Tapeats sandstone* and juts out to form a cliff over the first two layers. The fourth layer, known as the *Devonian layer*, consists of small deposits of lavender rock. Above this is the thick *Redwall*, which is 550 feet thick and which curves and turns along the lines of the canyon. Above the Redwall lies 800 feet of glowing red sandstone called the *Supai formation*. Another layer of red rock, known as the *Hermit shale*, covers this.

On top of the Hermit shale rests the sand-colored *Coconino sandstone*, a pale bank that lies 350 feet below



H. Armstrong Roberts

Towers of Rock Resembling Ancient Temples Were Carved When the Colorado River Gouged Out the Grand Canyon.

the rim of the canyon. The top layer of the canyon consists of cream and gray colored *Kaibab limestone*. This limestone forms a rim known as the Kaibab Plateau on the north side of the canyon, and as the Coconino Plateau on the south.

Animals and Plants. Among the 90 kinds of animals found in the park are mountain lions, deer, porcupines, beavers, lizards, and snakes. The Kaibab squirrel lives only on the north rim. The Abert squirrel is found only on the south rim. More than 180 kinds of birds are found in the park.

Desert cacti grow at the river level in the park. Delphinium, white thistle, poppy, and scarlet bugle grow in the dry regions. Prickly pears and pincushion cacti grow beneath the blue spruce and Douglas fir on the canyon rim.

History. Ruins of adobe houses in the Grand Canyon show that the Pueblo Indians lived in this area, probably as early as the 1200's. Spaniards from Francisco Vásquez de Coronado's expedition, in 1540, were the first white men to discover the canyon. The Colorado River was first navigated by John Wesley Powell (1834-1902). About 200 Havasupai Indians live in a remote section of Grand Canyon called Havasu Canyon. These Indians grow grain, fruit, and vegetables. The Grand Canyon area was set aside as a national park in 1919.

HERBERT E. KAHLER

See also ARIZONA (color picture); COLORADO RIVER; POWELL, JOHN WESLEY; PUEBLO INDIANS.

GRAND CANYON STATE. See ARIZONA.

GRAND CAVERNS. See VIRGINIA (Caverns and Springs).

GRAND COULEE DAM is the largest concrete dam and the greatest single source of water power in the United States. It stands across the Columbia River about 90 miles northwest of Spokane, Wash. It is near the head of the Grand Coulee, a steep-walled chasm where the Columbia once flowed. Grand Coulee Dam is the principal engineering feature of the Columbia Basin Project. The United States Bureau of Reclamation designed and built the dam, which is 4,173 feet long, 500 feet thick at the base, and 550 feet high, or about as high as a 46-story building. The dam was completed in 1941. It was built in less than 8 years, but is three times as large as the Great Pyramid of Egypt, which took 20 years to build. The dam contains 10,585,000 cubic yards of concrete, enough to build a two-lane highway twice the distance from New York City to Seattle, Wash. If this concrete were placed on an ordinary city block it would tower two and one-quarter times as high as the Empire State Building (1,250 feet without its television tower). The power plant at the dam houses 18 main generators driven by 150,000-horsepower turbines. During World War II, it provided more than 15 billion kilowatt-hours of electricity to industry.

Behind Grand Coulee Dam is a 151-mile-long reservoir, Franklin D. Roosevelt Lake. This reservoir will



Grand Coulee Dam harnesses the Columbia River in the state of Washington. The double-duty dam furnishes irrigation water for thousands of farms in the area. It also provides hydroelectric power for factories and homes.

Water reaches
land to be
irrigated

Water flows
to new lake in
old river bed

Penstocks
carry water to
canal

Pumps lift
water 280 feet

GRAND COULEE DAM

U. S. Bureau of Reclamation

eventually irrigate more than a million acres of land. Six of the 12 pumps were in operation by 1952. They are the world's largest, and raise the water 280 feet to a canal that flows into a 27-mile equalizing reservoir in the Grand Coulee. Each pump lifts 720,000 gallons of water a minute. Large-scale irrigation began in 1952. The project calls for the creation of about 13,000 family-size farms. Veterans have priority to buy the land owned by the government, which amounts to about a fifth of the area.

See also **WATER POWER**.

T. W. MERMEL

GRAND DIXENCE DAM is located in the Swiss Alps on the Dixence River in Switzerland. When completed in 1965, it will be the world's highest dam. Construction began in 1951 and is continuing in stages to

permit use of the dam while under construction. This gravity-type dam will be 932 feet high, have a crest length of 2,300 feet, and a volume of 7,540,000 cubic yards. Its reservoir will hold 325,000 acre-feet of water. The Grand Dixence Dam is part of a large power project in Switzerland. See also **DAM**.

T. W. MERMEL

GRAND FORKS, N.Dak. (pop. 34,451; alt. 835 ft.), is a shipping and food-processing center in the heart of the fertile Red River Valley. It ranks as the second largest city in the state. Grand Forks lies where the Red and Red Lake rivers meet (see **NORTH DAKOTA** [color map]). Farmers in the valley raise potatoes, wheat, flax, sugar beets, and livestock. Manufactured products include flour, meat, beet sugar, and fertilizer. Grand Forks has a lignite-research laboratory and a potato-

research laboratory. The University of North Dakota and Wesley College are there.

Grand Forks was founded in 1871 and incorporated in 1881. Trade was carried on in this area along the Old Red River Oxcart Trail in the early days of settlement. Today several railroads, bus lines, and an international airport serve the city. It has a mayor-council form of government. Grand Forks Air Force Base lies nearby.

See also NORTH DAKOTA, UNIVERSITY OF.

GRAND ISLAND, Nebr. (pop. 25,742; alt. 1,865 ft.), is an important shipping point for both farm and manufactured products. It is the seat of Hall County and the third largest city in Nebraska. Grand Island lies in farming and ranching country, at the eastern edge of the irrigated section of the Platte Valley. For location, see NEBRASKA (color map).

Grand Island has the oldest operating beet sugar factory in the United States. The city is famous for its cattle auctions. Stolley State Park is the site of Old Fort Independence, built to protect white settlers from the Indians in 1864. Grand Island was settled in 1857 and incorporated as a city in 1871. It has a mayor-council form of government.

JAMES C. OLSON

GRAND JUNCTION, Colo. (pop. 18,694; alt. 4,573 ft.), is the largest Colorado city west of the Continental Divide. The city received its name from its location at the junction of the Gunnison and Colorado (formerly the Grand) rivers. See COLORADO (color map).

Grand Junction is a trading center for western Colorado and eastern Utah. The surrounding area is rich in coal, livestock, oil, peaches, and vegetables. Colorado National Monument stands five miles west of the city. Grand Junction was founded in 1881. In 1909, it became the first city in the United States to use the preferential ballot in elections. Grand Junction has a council-manager form of government. It is the seat of Mesa County.

HAROLD H. DUNHAM

GRAND JURY. See JURY AND TRIAL BY JURY.

GRAND LAMA. See TIBET (Religion).

GRAND MAL. See EPILEPSY.

GRAND MONARCH. See LOUIS (XIV).

GRAND MUFTI. See SHEIK.

GRAND NATIONAL is the most famous steeplechase horse race in the world. It is run each year at the Aintree race course near Liverpool, England. Horses must be at least 6 years old to enter this grueling race of 4 miles, 856 yards. The course has 16 jumps, 14 of which must be taken twice. Most of the jumps consist of sturdy thorn fences up to 5 feet high. The course also has several water hazards. Often, only a small proportion of the starting horses finish the race. The first Grand National was held on Feb. 12, 1839, although it was not called by that name.

JOE AGRELLA

GRAND OLD PARTY, or **G.O.P.** See REPUBLICAN PARTY.

GRAND PORTAGE NATIONAL MONUMENT is located in northeastern Minnesota. It is the site of a historic nine-mile trail used by Indians and pioneers. Established in 1960, the monument covers 770 acres. It includes a replica of a log stockade.

GRAND PRÉ, *GRAN PRAY*, Nova Scotia (pop. 250; alt. 28 ft.), is a historic village on Minas Basin, about 15 miles northwest of Windsor. The name *Grand Pré* is French for *large meadow*. The French founded the village

GRAND RAPIDS

in about 1675. It served as one of the chief settlements of *Acadia*, which is now part of New Brunswick and Nova Scotia (see ACADIA).

At the end of Queen Anne's War in 1713, the French gave Acadia to the English. The Acadians, however, remained loyal to the French and continued close ties with the Indians. In 1747, a party of New England troops, quartered in the village, was betrayed and slaughtered by a raiding force of French and Indians. In 1755, the Acadians made a final refusal of the British oath of allegiance. A force of New England colonial troops gathered up the inhabitants of Grand Pré and deported them. Longfellow described this act in his poem *Evangeline*. A replica of the church of Saint Charles was dedicated in 1922, and is now a museum. The Acadians heard their orders of banishment in its churchyard. See NOVA SCOTIA (The Struggle in Acadia; picture, Evangeline Memorial Park).

GRAND RAPIDS, Mich. (pop. 177,313; alt. 610 ft.), is the third largest city in the state. It is often called the *Furniture Capital of America*. Grand Rapids furniture is famous for quality rather than quantity. Lumber from all parts of the world is sent there for furniture manufacture. Buyers throughout the country come to Grand Rapids each January and June for furniture markets. See FURNITURE (Furniture Industry in America).

Location and Description. Grand Rapids lies on the Grand River, 30 miles east of Lake Michigan. It is 60 miles northwest of Lansing. For location, see MICHIGAN (color map). More than one fourth of the people in Grand Rapids are of Dutch descent. Dutch, Polish, and Lithuanian workers were brought to the city by its furniture makers in the late 1800's and early 1900's. Many of their descendants still live there.

Grand Rapids serves as the center of wholesale trade in western Michigan. There are almost 700 manufacturing companies in the city. The manufacture of metal products ranks as the city's chief industry. Products include automobile parts and bodies, ball bearings, plumbing fixtures, and refrigerators. Other products are calliopes, fly paper, and folding paper boxes. The city also has more than 60 printing plants.

Farm products, especially grain and vegetables, are shipped from Grand Rapids. Winter lettuce shipped from there has been named after the city.

Grand Rapids is the seat of both Roman Catholic and Protestant Episcopal bishoprics. The Grand Rapids Junior College, established in 1916, was the first junior college in Michigan. Private colleges include Calvin College and Theological Seminary, and Aquinas College. The city has a public museum that stresses natural-history exhibits. A furniture museum presents a display on the evolution of household furniture.

History. Louis Campau founded a fur-trading post on the site of Grand Rapids in 1826. Earlier, an Ottawa Indian village stood there. The early growth of Grand Rapids was due to its location at the southern edge of Michigan's great pine forest. It became the center of supply, distribution, and transportation for the lumber industry. Although furniture was produced there as early as 1838, Grand Rapids furniture first gained national prominence at the Philadelphia Centennial

GRAND RIVER

Exposition in 1876. The Grand River has overflowed several times in the city's history, bringing great destruction. In 1881, one of the first hydroelectric power plants in the Midwest was built on the river.

Grand Rapids is the seat of Kent County, and has a council-manager form of government. WILLIS F. DUNBAR

GRAND RIVER. See HAMILTON RIVER; MICHIGAN (Rivers, Waterfalls, and Lakes); SOUTH DAKOTA (Rivers, Lakes, and Artesian Wells).

GRAND SLAM. See BRIDGE (Scoring).

GRAND TETON NATIONAL PARK, *TEA tun*, is an area of mountains, lakes, and forests in northwestern Wyoming, 6 miles south of Yellowstone National Park. It covers 310,350.18 acres. The Teton Mountains rise abruptly 5,000 feet from the level floor of Jackson Hole, a valley in the park. No foothills obscure the mountains from view. Many people consider them to be the most majestic mountains in North America. The highest peak in the range is Grand Teton (13,766 feet above sea level). This peak resembles the Matterhorn in Switzerland. More than 20 other mountain peaks in the park reach elevations higher than 10,000 feet above sea level.

A series of lakes formed by glaciers lies along the east side of the Tetons. The largest of these lakes, Jackson Lake, is partially artificial. A dam at the place where the Snake River flows out of the lake has raised its level. Water from Jackson Lake is used for irrigation in Idaho. Other lakes in the park include Phelps, Taggart, Bradley, Jenny, and Leigh.

Most of the trees in the park are evergreens. Wild animals that roam the forests include elk, moose, mule deer, mink, marten, and beaver. Several species of trout live in the lakes and streams. The Jackson Hole Biological Research Station operates in the park near the northern base of Signal Mountain. This station is administered by the University of Wyoming under agreement with the New York Zoological Society, and in cooperation with the National Park Service.

Grand Teton National Park was created in 1929, after efforts to incorporate the area in Yellowstone National Park had failed. It was enlarged in 1950. In that year, Congress abolished Jackson Hole National Monument, and most of its area was included in Grand Teton National Park. In the 1950's, the National Park Service abandoned the old town of Moran, and erased all evidence of the community. Fine new tourist accommodations were built nearby to replace Moran. T. A. LARSON

See also TETON RANGE; WYOMING (color picture, Grand Teton National Park).

GRAND TRIANON. See VERSAILLES.

GRAND UNION. See FLAG (First United States Flags; color picture, The Stars and Stripes).

GRAND VIZIER. See VIZIER.

GRANDEE, *gran DEE*, was the name for the royal family and several noble families of old Spain. They made up a separate, highly privileged class. The grantees enjoyed great power between 1200 and 1500. King Ferdinand and Queen Isabella took away most of their privileges, and Joseph Bonaparte abolished the class in 1812. The status of grantees was partly restored after 1814.

GRANDFATHER CLAUSE describes measures added to seven Southern state constitutions between 1895 and

1910 in order to allow white men to vote, while depriving Negroes of the privilege. These constitutions set up such high requirements for voting that they deprived many white men of the vote. The states then granted an exemption to anyone who had the right to vote on Jan. 1, 1867, and to his lineal descendants. Because no Negro had voted in the South before 1867, and because the voting requirements were especially high, these clauses disenfranchised almost all Negroes. In 1915, the Supreme Court of the United States declared grandfather clauses unconstitutional. See also UNITED STATES CONSTITUTION (Amendment 15).

DAVID DONALD

GRANDFATHER CLOCK. See CLOCK (picture).

GRANGE, *graynj*, NATIONAL, officially called the PATRONS OF HUSBANDRY, is one of the greatest farmers' organizations in the United States. From its beginnings shortly after the Civil War, the Grange has grown to represent the interests of farmers nationally.

Organization. The Grange is a fraternal order with its own secret ritual. It has about 8,000 local groups in nearly 40 states. Most members live in the northeastern and northwestern parts of the country. The Grange has a program of recreation and education for its members. Many local granges build their own halls, which serve as meeting and recreation centers for rural communities. The Grange works with the federal Department of Agriculture and with state departments to spread farm education. It helps farmers' groups promote laws of benefit to farmers. The Grange maintains its national headquarters at 1616 H Street N.W., Washington 6, D.C.

History. The Grange was founded in 1867 by Oliver Hudson Kelley (1826-1913), a government clerk, and six associates. Kelley had toured the South for the Bureau of Agriculture. He had found the farmers poor, discouraged, and ignorant. He believed a fraternal order would attract members and give the farmers a chance to learn advanced farming methods.

In 1868, Kelley went to Minnesota, his home state, and began organizing local bodies called *granges*. The movement spread rapidly, and soon the Grange became an agricultural force in the Midwest. There were 850,000 members in more than 21,000 granges by 1875. Farmers used the Grange to organize opposition to the unfair practices of the railroads. Freight charges remained high, although farm prices had dropped. The Granges secured the passage of state laws to limit railroad rates. The Grangers also wanted an income tax, laws against trusts, and other measures which later became law.

Some of these projects failed, and the Grange lost many of its members in the 1880's. The organization began to grow again in the 1890's and succeeded in building a large membership on the basis of its social, legislative, and educational programs. ROY BATTLES

See also COOPERATIVE; WAITE, MORRISON REMICK. **GRANGE, "RED," HAROLD** (1903-), won fame as one of the greatest football players of all time. He became known as the *Galloping Ghost* when he scored five touchdowns the first five times he carried the ball for the University of Illinois against the University of Michigan in 1924. Later, he played professional football with the New York Yankees and the Chicago Bears. In the late 1940's, he became a sports commentator on radio and television. He was born at Forksville, Pa.

FOREST EVASHEVSKI

GRANITE, *GRAN* it, is a hard crystalline rock, made up chiefly of mineral crystals such as quartz and feldspar, and a few dark-colored minerals.

Granite is light colored, and its crystals are large enough to be seen with the naked eye. One can study them on the polished surfaces of granite blocks used on monuments or buildings. The quartz is transparent, much like glass. The feldspar crystals are more or less rectangular, and are colored a dull white, gray, or pink, like fine porcelain. On a natural broken surface the feldspar grains are so smooth that they reflect sunlight.

The quartz grains do not break along smooth plane surfaces like the feldspar. The dark-colored minerals, chiefly black mica and hornblende, are scattered in the mass of quartz and feldspar crystals. Their dark color makes them quite noticeable.

The individual crystals in most granite measure from a small fraction of an inch to about half an inch wide. Some granite is coarse-grained. It has large crystals of feldspar one to several inches long, scattered through the mass of ordinary crystals. They look somewhat like angular almonds scattered in coarse sugar. This kind of rock is called *granite porphyry*.

How Granite Is Formed. All granite was once melted rock like lava. It did not come to the earth's surface, but hardened thousands of feet under the ground. It cooled slowly, and thus had time to form fairly large crystals as it hardened. Where such lava poured out on the surface, it cooled so quickly that it did not have time to form large crystals. It now forms a rock that is so finely grained that its crystals can be seen only through a microscope. This sort of lava is called *ryholite*. It is chemically the same as granite. Only its structure is different.

In many regions of the United States and elsewhere, geologic upheavals in past ages have brought the granite from deep in the earth to near the surface where it now is broken or blasted out in deep pits or *quarries*.

TEN LEADING GRANITE STATES

Georgia.....	162,300	         
Massachusetts.....	112,300	    
Vermont.....	72,700	   
Minnesota.....	59,600	 
North Carolina.....	40,800	 
Maryland.....	35,500	 
South Dakota.....	19,300	
Maine.....	13,800	
Pennsylvania.....	12,600	
California.....	12,300	

Each symbol  stands for 20,000 tons of granite for building purposes.

Based on government statistics for a 4-year period.



Esso Oilways

Granite in a Vermont Quarry shows the long drill marks by which slabs are blasted and split off from the huge stone mass.

Uses of Granite. Much granite is used in building bridges and buildings. It is valuable as a support where great strength is required, for granite can withstand a pressure of 15,000 to 20,000 pounds per square inch. It is also used for monuments because it can be polished so smoothly, and at the same time is hard and not easily damaged. Carvings and inscriptions on granite withstand weather for hundreds of years. This increases its value as a building material.

Where It Is Found. Granite for building stone is quarried in 10 states. Granite used for monuments is quarried in Vermont, Minnesota, Wisconsin, Massachusetts, California, Georgia, Rhode Island, North Carolina, New Hampshire, and Maine. Many of the western states produce granite, but it is used only locally because its heavy weight makes transportation costs high. Quarrymen and builders often use the name *granite* for many other rocks which resemble granite, but are differently composed and constructed.

Several other countries also quarry granite, and the United States imports some of their production. Some is brought in from Canada. Both Sweden and Finland were important exporters to the United States before World War II. Finland's *red granite* is desired for polished monuments because of its color.

ERNEST E. WAHLSTROM

Related Articles in WORLD BOOK include:

Barre	Georgia (color picture, Stone Mountain)	Mica
Building Stone	Gneiss	Porphyry
Crystalline Rocks	Igneous Rock	Quarrying
Feldspar		Quartz

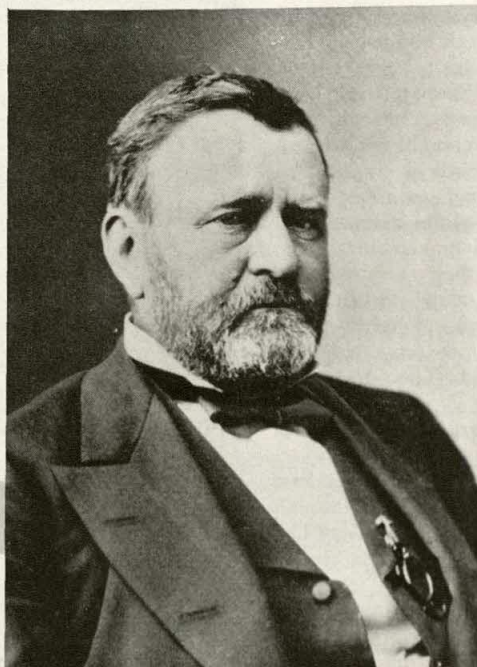
GRANITE PEAK. See MONTANA (Land Regions).

GRANITE STATE. See NEW HAMPSHIRE.

GRANT, HEBER J. See UTAH (Famous Utahans).

ULYSSES S. GRANT

U. S. Grant



The United States Flag had 37 stars throughout Grant's term of office.



LINCOLN
16th President
1861 — 1865



JOHNSON
17th President
1865 — 1869



HAYES
19th President
1877 — 1881



GARFIELD
20th President
1881

Brown Bros.

18TH PRESIDENT OF THE UNITED STATES 1869-1877

GRANT, ULYSSES SIMPSON (1822-1885), commanded the victorious Union armies at the close of the Civil War in 1865. His success and fame as a general led to his election as President in 1868. During his military career, Grant led his troops with energy and determination. He developed great confidence in his own judgment, and an ability to learn from experience. These traits also characterized Grant's political career. But the qualities which had brought him military glory were not enough to solve the nation's problems in the 1870's. Grant's enemies called him a poor President, and historians have generally agreed.

Grant was the first West Point graduate to become President. A quiet, unassuming man, he had an almost shy manner. He was short and stocky, and did not look like a leader of men. Clever and dishonest men used President Grant as a tool to promote their own evil schemes. His presidency was clouded by disgrace and dishonesty, partly because of his habit of trusting persons who pretended to be his friends. Congressional investigations revealed widespread corruption in both state and federal governments. A severe financial panic in 1873 caused the people to react against Grant. To many Americans, he symbolized the confusion and corruption of the times. Grant ignored the attacks on him and the Republican party. He believed that all the criticism came only from political opponents.

Two months after Grant became President in 1869, the nation's first transcontinental railroad was completed. In October, 1871, the great Chicago fire killed about 250 persons and left more than 90,000 homeless. In 1872, Congress established Yellowstone National Park, the first national park in the United States. Alexander Graham Bell invented the telephone in 1876.

That same year, in the Battle of the Little Big Horn, Sioux and Cheyenne warriors massacred about 225 men under General George A. Custer.

Early Life

Boyhood. Ulysses Grant was born on April 27, 1822, in Point Pleasant, Ohio, a village on the Ohio River about 20 miles southeast of Cincinnati. He was the first child of Jesse and Hannah Simpson Grant. They named their son Hiram Ulysses Grant, but always called him Ulysses or 'Lyss. The year after Ulysses was born, the family moved to nearby Georgetown, Ohio, where his father owned a tannery and a farm. Grant's two brothers and three sisters were born in Georgetown.

Jesse Grant prospered in his tannery. The shy and retiring Ulysses disliked working in the tannery, but enjoyed farm work and managing horses. He became an excellent horseman. Ulysses was honest and trustworthy, and his father often sent him on business trips.

Education. Ulysses attended school in Georgetown until he was 14. He then spent one year at an academy

IMPORTANT DATES IN GRANT'S LIFE

- 1822** (April 27) Born in Point Pleasant, Ohio.
- 1843** Graduated from West Point.
- 1848** (Aug. 22) Married Julia Dent.
- 1854** Resigned from the army.
- 1861** Appointed a colonel of Illinois volunteers.
- 1863** Led Union troops to victory at Vicksburg, Miss.
- 1864** Named supreme commander of Union forces.
- 1865** (April 9) Accepted the surrender of Confederate forces under General Robert E. Lee.
- 1868** Elected President of the United States.
- 1872** Re-elected President.
- 1880** Defeated in bid for presidential nomination.
- 1885** (July 23) Died in Mount McGregor, N.Y.

in nearby Ripley, Ohio. Early in 1839, his father learned that a neighbor's son had been dismissed from the U.S. Military Academy. Jesse asked his Congressman to appoint Ulysses as a replacement. The Congressman made a mistake in Grant's name. He thought that Ulysses was the youth's first name, and his middle name that of his mother's family. He made out the appointment to Ulysses Simpson Grant. Ulysses never corrected the mistake. He thought his classmates might tease him about his real initials, "H.U.G."

Grant was only an average student at West Point, but he made a fine record in horsemanship. His classmates remembered him as lazy in his studies and careless in drill. But many recalled his quick perception and common sense. Ulysses disliked military life, and had no intention of making the army his career. He thought he would like to teach mathematics in a college.

Early Army Career. Grant was graduated from West Point in 1843, and was commissioned as a second lieu-

GRANT, ULYSSES S.

tenant. He was assigned to the Fourth Infantry Regiment, then stationed in St. Louis. There he met Julia Dent (Jan. 26, 1826-Dec. 14, 1902), the sister of a classmate. They fell in love, and soon became engaged. The threat of war with Mexico delayed their wedding.

Grant's regiment was sent to Texas in 1845. He was there when the Mexican War began. Grant served as regimental quartermaster, in charge of organizing supplies. At Monterrey, he volunteered to carry a message through streets lined with enemy snipers. In 1847, Grant's regiment went to Veracruz. Grant fought at Cerro Gordo, and took part in the storming of Chapultepec. He reached the rank of first lieutenant by the end of the war. Grant's experiences taught him lessons which helped him later during the Civil War.

Grant's Family. Grant returned to St. Louis as soon as he could leave Mexico. On Aug. 22, 1848, he was

THE WORLD OF PRESIDENT GRANT

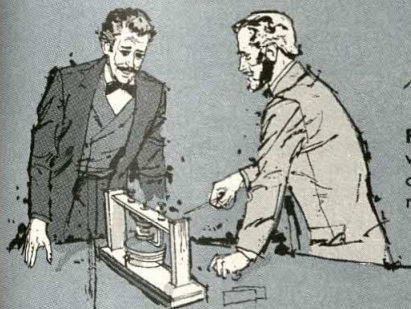
U.S. population was 47,141,000 in 1877. Colorado became a state in 1876. No new territories were created by Congress during Grant's administration.



COLORADO



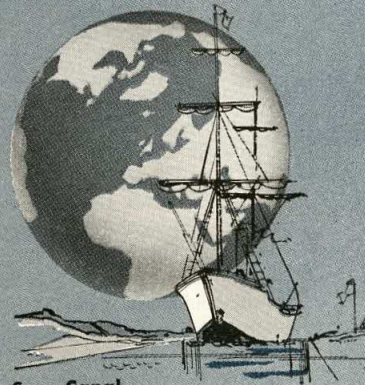
The Yellowstone Area was set aside by Congress in 1872 as the first national park.



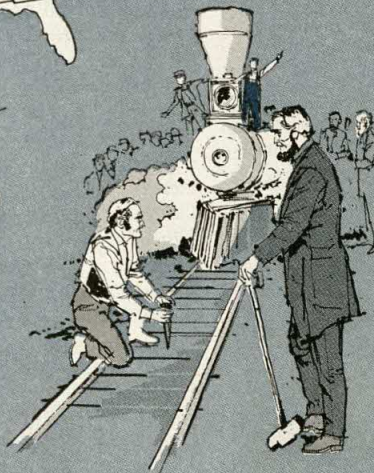
Inventions. Alexander Graham Bell invented the telephone in 1876. Barbed wire was developed in 1873.

WORLD EVENTS

- 1869 The Suez Canal opened.
- 1870 Canada bought vast territories from the Hudson's Bay Company.
- 1870-71 The Franco-Prussian War resulted in the unification of Germany.
- 1871 Heinrich Schliemann discovered ancient Troy.
- 1877 Queen Victoria was proclaimed Empress of India.



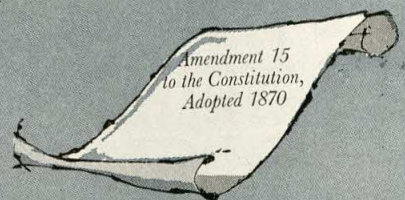
Suez Canal



First Transcontinental Railroad was completed in 1869. The tracks of the Union Pacific and Central Pacific railroads met at Promontory, Utah.



Indians Massacred Custer and his troops in the Battle of the Little Bighorn in 1876.



Amendment 15, proclaimed in 1870, insures citizens the right to vote, regardless of race.

GRANT, ULYSSES S.

married to Miss Dent. She was a devoted wife, and gave Grant constant encouragement. Their life together brought them great happiness. The Grants had four children: Frederick Dent, Ulysses Simpson, Ellen (Nellie) Wrenshall, and Jesse Root.

Resignation from the Army. Grant remained in the army after his marriage because he hesitated to risk the uncertainties of civilian life. For several years, he was stationed at various army posts. Then, in 1851, he was ordered to Fort Vancouver in Oregon. Grant did not take his family on the journey because his army pay would not support a family in the West, where living costs were high. Mrs. Grant and their son Frederick went to live with Grant's parents in Ohio.

Fort Vancouver was a lonely post. Separated from his family, Grant became depressed and began to drink heavily. He won promotion to captain in 1853, and was transferred to Fort Humboldt in California. But even a captain's pay was too small to support a family in the West. Grant continued to drink excessively. In 1854, his commanding officer ordered him to reform or resign. Grant resigned, and settled with his family in St. Louis. Several times in later years, Grant's critics charged that he was drinking heavily. But no formal proof of these charges was ever offered.

Business Failures. For the next six years, Grant's life was one of failure. Mrs. Grant's father gave her a farm near St. Louis, and Grant built a cabin there which he named *Hardscrabble*. The family lived on the farm for three years, from 1855 to 1858. Grant liked farming, but he failed because the land was so poor. He sometimes peddled firewood in the streets of St. Louis.

In 1859, Grant sold the farm and moved to St. Louis. A relative gave him a job in a real estate office, but Grant could not collect rents. He next obtained, then lost, a job in the U.S. Customs House. During this period, Grant's brothers opened a leather goods store in Galena, Ill. Urged by their father, the brothers in 1860

The Birthplace of Grant still stands in Point Pleasant, Ohio. His family moved to a farm in nearby Georgetown, Ohio, when he was about one year old, and Grant spent his childhood there.

The Ohio Historical Society



offered Ulysses a \$50-a-month job in the store. Grant accepted, but he showed no ability as a storekeeper.

Civil War General

Return to the Army. Grant was almost 40 years old when the Civil War began. He had taken no interest in public affairs. His father bitterly opposed slavery, but Grant had expressed no opinion about the problem. He opposed secession, but never took more than a passing interest in the crisis until the war began.

When President Abraham Lincoln called for army volunteers, Grant helped drill a company that was formed in Galena. Then he went to Springfield, the state capital, and worked for the Illinois adjutant general. Grant asked the federal government for a commission as colonel, but his request was ignored. After several months, Governor Richard Yates appointed him colonel of the 21st Illinois Volunteers. Grant led these troops on a campaign against Confederate guerrillas in Missouri.

During two months of campaigning, Grant refreshed his memory about handling troops and supplies. Upon the recommendation of Elihu B. Washburne, an Illinois Congressman, President Lincoln promoted Grant to brigadier general in August, 1861. Grant selected a young Galena lawyer named John A. Rawlins to serve on his staff. Rawlins soon became Grant's closest adviser, critic, friend, and defender.

"Unconditional Surrender" Grant. Steadily Grant revealed the qualities of a great military commander. He took the initiative, fought aggressively, and made quick decisions. Grant established his headquarters at Cairo, Ill., in August, 1861. He soon learned that Confederate forces planned to seize Paducah, Ky. Grant ruined this plan by occupying the city. On Nov. 7, 1861, his troops drove the Confederates from Belmont, Mo., but the enemy rallied and retook the position.

In January, 1862, Grant persuaded his commanding officer, General Henry W. Halleck, to allow him to attack Fort Henry, on the Tennessee River. Grant captured the fort easily. On his own initiative, he then lay siege to nearby Fort Donelson. When the fort commander asked for terms of surrender, Grant replied: "No terms except an unconditional and immediate surrender can be accepted." The Confederate commander realized he had no choice but to accept what he called Grant's "ungenerous and unchivalrous" demand. Northerners joyfully declared that Grant's initials, U. S., stood for "Unconditional Surrender." Grant was promoted to major general after he captured the forts.

Grant learned from his mistakes. On April 6, 1862, the Confederates opened the Battle of Shiloh by launching a surprise attack on Grant's forces at Pittsburg Landing, Tenn. The Union troops barely held off the enemy until reinforcements arrived. Grant was never again surprised in battle.

Grant was severely criticized for the heavy Union losses at Shiloh. Rumors sprang up that he had returned to his former bad habits and was drinking again. Early in June, 1862, General Halleck became commander of the Union armies in the East, and Grant was given command of all troops in the West. Many Congressmen urged Lincoln to replace him. Lincoln replied: "I can't spare this man—he fights!"

Persistence brought Grant a great victory at Vicks-

burg, Miss. All through the winter of 1862-1863, his troops advanced against this last Confederate stronghold on the Mississippi River. In May, 1863, Grant defeated a Confederate army, then besieged the city. On July 4, 1863, the Confederates surrendered.

Grant's willingness to make decisions saved the Union army which was under siege at Chattanooga, Tenn. Upon taking command there in October, 1863, Grant found that plans had been made for breaking the siege. He ordered the plans put into effect at once. On Nov. 24-25, 1863, his troops won a sweeping victory.

Supreme Commander. Grant succeeded consistently in the West, while Union generals in the East were failing. Early in 1864, Lincoln promoted Grant to lieutenant general and put him in command of all Union armies. Grant went to Virginia and began a campaign against the forces of General Robert E. Lee.

Grant's troops suffered severe losses in several battles as he forced Lee to retreat slowly toward Richmond, Va., the Confederate capital. Many critics in the North called Grant a "butcher" because he lost so many men. After a bloody battle at Spotsylvania Court House on May 8-12, 1864, Grant declared: "I propose to fight it out on this line if it takes all summer." Actually, it took all summer, fall, and winter.

The fierce pressure of the Union army forced Lee to abandon Richmond early in April, 1865. Grant quickly pursued him, and Lee surrendered on April 9, 1865, at Appomattox Court House, Va. Grant released Lee and his soldiers on their honor, and allowed the men to keep their horses "for the spring plowing."

National Hero. Grant's victory won him great popularity in the North. Southerners appreciated his generous terms to Lee. Success gave Grant confidence, and erased memories of his failures in civilian life.

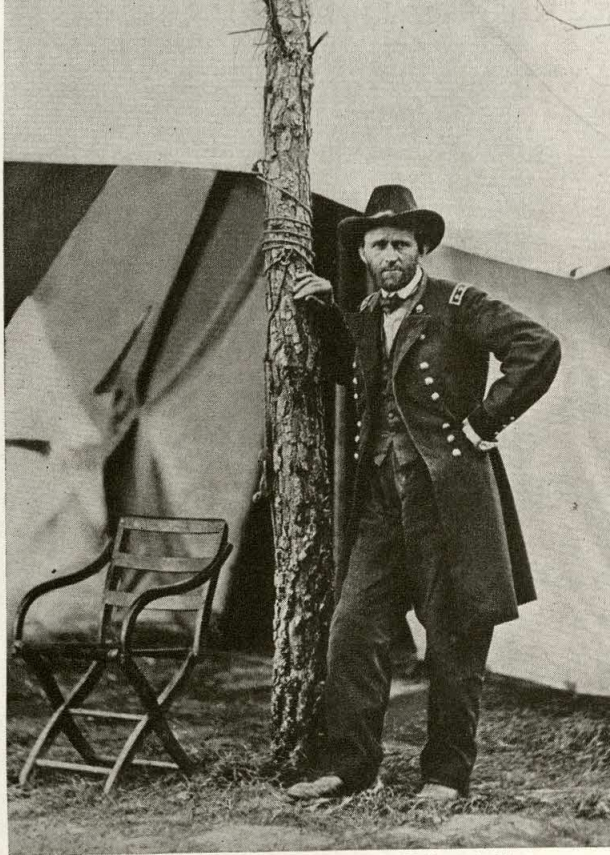
After the Civil War, a bitter conflict developed between President Andrew Johnson and the Radical Republicans in Congress. This group of Republicans demanded harsh treatment of the former enemy. Johnson favored a mild Reconstruction program. At first, Grant sided with Johnson. But the Radical Republicans won control of Congress in 1866. Grant concluded that the people had turned against Johnson.

In 1867, Johnson suspended Secretary of War Edwin M. Stanton, and appointed Grant to replace him. But the Senate refused to approve the suspension of Stanton (see **TENURE OF OFFICE ACT**). Grant gave up the office to Stanton, and broke with Johnson publicly. Grant then gave his full support to the Radical Republicans.

Election of 1868. The Republicans badly needed a popular hero for their presidential candidate in 1868. The Democratic party still controlled many large Northern states and a great percentage of the electoral votes. Delegates to the Republican national convention nominated Grant unanimously on the first ballot. They chose Speaker of the House Schuyler Colfax of Indiana for Vice-President. The Democrats nominated former Governor Horatio Seymour of New York for President, and former Representative Francis P. Blair, Jr., of Missouri as his running mate. Grant defeated Seymour by a decisive majority of the electoral votes.

Grant's First Administration (1869-1873)

Inauguration. In his inaugural address on March 4, 1869, Grant admitted that he had no political experi-



National Archives

Grant Became Supreme Commander of Union armies in 1864, after his many victories over Confederate forces. Mathew Brady, the famous Civil War photographer, took this picture of Grant near the front in Virginia during the last bloody months of the war.

ence. But he promised that he would not be ruled by professional politicians. "The office has come to me unsought," he said. "I commence its duties untrammelled." Grant's selections for his Cabinet showed his independence from the Republican party. He did not consult party leaders about his appointments. For other government offices, Grant chose personal friends and army officers. He also appointed some relatives.

Reconstruction Policies. Grant's administration worked to maintain Republican control over the South. Groups such as the Ku-Klux Klan had been organized in the South to keep Negroes from voting. The Republicans feared that their hold on the South would be weakened without Negro support. In 1870 and 1871, Congress passed three *force bills* to enforce the voting rights of Negroes. See **FORCE BILL**; **RECONSTRUCTION**.

Political Corruption spread to all levels of government during Grant's terms in office. In the South, Negroes and Northern adventurers known as *carpetbaggers* dominated the state governments, which were often corrupt (see **CARPETBAGGER**). In Northern cities, political machines such as the Tweed Ring in New York City made huge profits from graft on city contracts. Scandals came to light even in the federal government. The President himself was honest, but some of his appointees were men of low standards.

Part of the reason for the low state of public morality

GRANT, ULYSSES S.

was the spoils system, which gave great power to politicians. Under this system, successful political candidates rewarded their supporters by giving them government jobs. Many incapable or dishonest persons received high government positions. Grant tried to change the system, and urged Congress to adopt measures which would bring a merit system into government service. But Congress refused to appropriate money for a civil service commission that would regulate government jobs. The scandals that soon developed showed the need for civil service reform.

One scandal began during the summer of 1869. Jay Gould, James Fisk, Jr., and other financial speculators tried to *corner*, or gain control of, the gold market by buying all the gold available in New York City. They planned to force bankers and businessmen to buy gold from them at highly inflated prices. The only way this corner on the gold market could be broken was by having the federal government sell some of its own gold. But Grant's brother-in-law, Abel R. Corbin, assured the plotters that he could persuade the President not to permit the sale of government gold.

Corbin had no government position, but Gould and Fisk accepted his word because he was a close relative of Grant. Then, on September 24, which became known as Black Friday, Secretary of the Treasury George S. Boutwell authorized the Treasury to sell gold to anyone who needed it to pay business debts. When the scandal was revealed, many persons felt that some kind of civil service reform was necessary. See BLACK FRIDAY.

Foreign Relations. In 1869, the president of the Dominican Republic offered to sell his country to the United States. Grant's secretary, General Orville Babcock, signed a treaty of annexation with the Negro republic. Senator Charles Sumner of Massachusetts, chairman of the Senate Foreign Relations Committee, attacked the treaty and denounced Grant. Sumner, an ardent supporter of political rights for Negroes, was angered at the thought of a Negro republic losing its independence. The Senate rejected the treaty. After that, Grant regarded Sumner, Carl Schurz of Missouri, and other Senators who had opposed him as personal enemies.

The government had more success in its relations with Great Britain. The *Alabama* and other Confederate warships built in Britain had destroyed much Northern shipping during the Civil War. The United States claimed that Britain should pay for this damage. On May 8, 1871, the two countries signed the Treaty of Washington. They agreed to submit the claims to an arbitration commission in Switzerland. The Geneva Tribunal of 1872 ruled that Great Britain should pay

GRANT'S FIRST ELECTION

Place of Nominating Convention.	Chicago
Ballot on Which Nominated.	1st
Democratic Opponent.	Horatio Seymour
Electoral Vote.	214 (Grant) to 80 (Seymour)
Popular Vote.	3,013,421 (Grant) to 2,706,829 (Seymour)
Age at Inauguration.	46

GRANT'S CABINET

Secretary of State.	†Elihu B. Washburne *Hamilton Fish (1869)
Secretary of the Treasury.	George S. Boutwell William A. Richardson (1873) Benjamin H. Brewster (1874) Lot M. Morrill (1876)
Secretary of War.	John A. Rawlins *William T. Sherman (1869) William W. Belknap (1869) Alphonso Taft (1876) James D. Cameron (1876)
Attorney General.	E. Rockwood Hoar Amos T. Akerman (1870) George H. Williams (1872) Edward Pierpont (1875) Alphonso Taft (1876)
Postmaster General.	John A. J. Creswell James W. Marshall (1874) Marshall Jewell (1874) James N. Tyner (1876)
Secretary of the Navy.	Adolph E. Borie George M. Robeson (1869)
Secretary of the Interior.	Jacob D. Cox Columbus Delano (1870) *Zachariah Chandler (1875)

*Has a separate biography in WORLD BOOK.
†See the article ILLINOIS (Famous Illinoisans).

the United States \$15,500,000. See ALABAMA (the ship).

Life in the White House. Grant took little part in Washington social life except for official appearances. The shy, retiring President reserved his warmth and affection for his family. Grant followed a simple daily routine. He arose early and read the newspapers until breakfast. After a short walk, he went to his office, where he carried on official business until 3 P.M. He took another stroll, ate dinner, then read newspapers or visited with friends until 10 or 11 o'clock.

In 1874, Grant's daughter Nellie married Algernon Sartoris, a wealthy Englishman. Their wedding in the White House attracted international attention.

Election of 1872. Grant's first administration achieved some real success. The national debt was reduced, and the dispute with Great Britain over war claims was settled. But Grant offended some politicians, and disappointed others who wanted civil service reform. In addition, men who favored free trade opposed the high tariff then in effect.

Discontented Republicans held a convention of their own. They called themselves Liberal Republicans. Senator Schurz and a group of journalists dominated the convention. They nominated Horace Greeley, editor of the *New York Tribune*, for President, and Governor B. Gratz Brown of Missouri for Vice-President.

The Democrats also nominated Greeley for President. They hoped that by combining with the Liberal Republicans, they might overthrow the corrupt Republican administration of Grant. But the Democrats were hardly less corrupt than the Republicans. Their political machines in several big cities had swindled the taxpayers of millions of dollars. Also, Greeley had been an ardent Republican and a supporter of the high tariff, which many Democrats opposed. The Democrats and Liberal Republicans found it difficult to cooperate.

Grant's Republicans presented a united front. Experienced politicians led the party's campaign. In addition, the Republicans knew they could count on the Negro vote of the South. The party renominated Grant

Grant and His Family. This picture, painted by William Cogswell in 1868, shows Jesse, Ulysses, Jr., and Mrs. Grant, front row, left to right. Nellie and Frederick Dent stand next to their father in the rear.



Grant's Home in Galena, Ill., was presented to the general after the Civil War. The home is now a state memorial.

United Press Int.



The Smithsonian Institution

for President, and named Senator Henry Wilson of Massachusetts as his running mate. Grant won re-election by a greater majority than he had received in 1868.

Grant's Second Administration (1873-1877)

Grant's second term got off to a bad start as Congress investigated the Credit Mobilier, a construction company owned by the Union Pacific Railroad. The investigation revealed that many Congressmen had taken bribes from the firm to do favors for the Union Pacific. Congress reprimanded several men involved in the scandal. See CREDIT MOBILIER OF AMERICA.

The Panic of 1873. In September, 1873, several important eastern banks failed, and a financial panic swept the country. Hardest hit by the panic were bankers, manufacturers, and farmers of the South and West. In an attempt to gain relief, the bankers and manufacturers formed the Greenback party, and the farmers organized the Grange movement and the Farmers' Alliance. These groups demanded an inflation of the currency to ease the depression (see INFLATION AND DEFLATION [Effects of Inflation and Deflation]).

Under such pressure, Congress passed an inflation

bill which would have added \$18,000,000 to the paper currency in circulation. But Grant vetoed the bill because the Republicans had promised to resume specie payments (see SPECIE PAYMENTS, RESUMPTION OF).

Government Frauds. The voters reacted strongly to the panic and to continued evidence of corruption in government. Grant himself showed poor judgment by accepting personal gifts. The Democrats won a sweeping victory in the Congressional elections of 1874. The new Congress investigated the Whisky Ring, which Secretary of the Treasury Benjamin H. Bristow had uncovered. The investigators found that whisky distillers in St. Louis and other cities had conspired with tax officials to rob the government of excise taxes. The investigators also charged that Grant's secretary, General Babcock, had protected the ring from exposure. Grant stoutly defended Babcock, who was cleared of the charges. Many other officials were convicted of defrauding the government. See WHISKY RING.

In 1876, another investigation revealed that Secretary

GRANT'S SECOND ELECTION

Place of Nominating Convention	Philadelphia
Ballot on Which Nominated	1st
Democratic-Liberal Republican Opponent	Horace Greeley
Electoral Vote	286 (Grant) to 3 (Greeley)*
Popular Vote	3,596,745 (Grant) to 2,843,446 (Greeley)

Age at Inauguration 50
*Greeley died three weeks after the election, and the presidential electors split their votes among a number of persons. The three votes cast for Greeley were not actually counted.



Gendreau

Grant's Tomb stands on Riverside Drive in New York City. Over 90,000 persons donated money to build the \$600,000 monument, which was completed in 1897. Grant's wife is buried beside him.

of War William W. Belknap had accepted bribes from a trader at an Indian post. Belknap resigned, but the House of Representatives impeached him anyway. He was acquitted on a technicality. Just before the Republican national convention of 1876, rumors arose of suspicious connections between the Union Pacific Railroad and James G. Blaine, former Speaker of the House.

The growing list of scandals left Grant unmoved. He thought that the Democrats and reformers were only seeking to make political gains by exposing corruption. Perhaps Grant wanted to be nominated for a third term as President. But the Republicans knew that they had to choose a man who had not been touched by scandal. They nominated Rutherford B. Hayes, who won the presidency by a margin of only one electoral vote.

Later Years

Grant and his family traveled in Europe and the Far East for more than two years after he left office. The trip was suggested by political bosses in the Stalwart group of the Republican party (see HAYES, RUTHERFORD B. [Campaign of 1876]). They planned to nominate Grant for a third term in 1880, and thought the trip would restore his popularity. Newspapers described the enthusiastic welcomes Grant received wherever he went. When Grant returned home in 1879, he had regained much of his old popularity. He settled in a home in Galena, Ill., which had been presented to him after the Civil War. Grant lived there until 1881, when he moved to Mount McGregor, near Saratoga, N.Y.

At the Republican national convention of 1880, the Stalwarts controlled the votes of 306 delegates. These delegates voted for Grant through 35 ballots. Senator-elect James A. Garfield of Ohio won the nomination on

the 36th ballot. When Grant learned of this, he said: "I feel a great responsibility lifted from my shoulders."

Grant retired to private life with savings that totaled about \$100,000. He invested all his money in the banking firm of Grant & Ward. His son, Ulysses, Jr., was a partner in this company, although he was not the Grant listed in the name of the firm. Grant knew nothing about banking, but his son assured him that Ferdinand Ward was a financial genius. Ward turned out to be dishonest, and the company failed in 1884. The collapse of the company left Grant almost penniless.

To make a living, Grant began writing magazine articles about his war experiences. Soon he announced he would write his memoirs. Mark Twain, the famous author, became his publisher. The memoirs were a great success, earning Grant's family \$500,000.

Grant knew he was dying of cancer when he wrote his memoirs. But he was cheered by the good wishes of the American people, who had forgotten their bitterness over his administration. Grant died at Mount McGregor on July 23, 1885, two months after completing his memoirs. His body lies in a tomb in New York City. Mrs. Grant died in 1902, and was buried at his side.

Authoritative books about Grant include *Ulysses S. Grant: Politician* by William B. Hesseltine, *Captain Sam Grant* by Lloyd Lewis, and *Grant Moves South* by Bruce Catton.

W. B. HESSELTINE

Related Articles in WORLD BOOK include:

Civil War	Mexican War
Colfax, Schuyler	President of the United States
Illinois (picture, Ulysses S. Grant Home)	Reconstruction
Lee, Robert Edward	Wilson, Henry

Outline

- I. Early Life
 - A. Boyhood
 - B. Education
 - C. Early Army Career
 - D. Grant's Family
 - E. Resignation from the Army
 - F. Business Failures
- II. Civil War General
 - A. Return to the Army
 - B. "Unconditional Surrender" Grant
 - C. Supreme Commander
 - D. National Hero
 - E. Election of 1868
- III. Grant's First Administration (1869-1873)
 - A. Inauguration
 - B. Reconstruction Policies
 - C. Political Corruption
 - D. Foreign Relations
 - E. Life in the White House
 - F. Election of 1872
- IV. Grant's Second Administration (1873-1877)
 - A. The Panic of 1873
 - B. Government Frauds
- V. Later Years

Questions

- Why did Grant not use his real first name?
- Why did the Democrats combine with the Liberal Republicans in 1872?
- When did Grant start writing magazine articles? Why?
- What nickname was given to Grant after the capture of Fort Donelson? Why?
- In what subject did Grant excel at West Point?
- Why did the Senate oppose Grant's plan to annex the Dominican Republic?
- Why did President Lincoln make Grant supreme commander of the Union army?
- Why did the Republicans nominate Grant in 1868?
- What famous remark on the battlefield of Spotsylvania showed Grant's persistence and courage?
- How did Grant react to charges of corruption in his administration?



Hudson River Vineyards in New York produce hundreds of tons of plump Concord grapes each autumn. The sweet, juicy fruit is processed nearby and sent on to commercial food and wine manufacturers.



J. Horace McFarland; Rohm & Haas Reporter

GRANULATION is a process by which the body heals open wounds. When a person is wounded, blood flows into the wound and clots to form a crust, or scab. The scab provides a protective covering while new tissues form. Granulation tissue begins to grow. This tissue looks like a layer of pink granules because it is formed by many tiny blood vessels. The delicate new tissue bleeds easily. But there is no feeling in it, for nerves have not yet grown into the area. New tissue cells made by the body move into the granulating mass. These cells grow until they fill the open area of the wound. In the meantime, the area of new growth is protected from infection by white blood cells that surround and destroy any germs. Occasionally, during the process of healing, granulation tissue pushes beyond the edges of the wound. This excess growth is called *proud flesh*. Doctors may remove this tissue by surgery or by using strong caustics to destroy it.

ALBERT P. SELTZER

GRANVILLE-BARKER, HARLEY (1877-1946), was a British actor, playwright, producer, and student of the theater. Though he appeared in and produced plays by Shakespeare and other early writers, his chief interest was in the then new type of drama of Henrik Ibsen and George Bernard Shaw. His own plays include *The Voysey Inheritance* (1905), *Waste* (1907), and *The Madras House* (1910). They resemble the dramas of Ibsen and Shaw. Granville-Barker was born in London. LEO HUGHES

GRAPE is the smooth-skinned, juicy fruit of a woody vine. Many Bible stories mention the grape, and references to it appear in the myths, fables, and poetry of many peoples of the world. It is one of the oldest cultivated plants. Grapes grow in temperate regions throughout the world and are used in many ways. They can be eaten fresh, dried into raisins, or made into grape juice, wine, or jelly. The dried, or *Zante*, currant used in puddings and bakery products is really a small raisin.

Not only is the grape juice and pulp useful, but various products are made from the skins and seeds. The purple-colored label stamped on meats by packers and government inspectors is made from the skins of dark grapes. Grape-seed oil is used to make mayonnaise and potato chips. Packers also spray it on raisins to keep them from becoming sticky.

Kinds of Grapes

Several hundred varieties of grape vines are cultivated. But some are confined to particular countries.

European Grapes. The *European, vinifera*, or *Old World*, grape was the first to be cultivated. It grows wild in southeastern Asia, but was transplanted to Europe and cultivated there. Early Spanish missionaries brought vines of the Old World grape to America. But these plants did not grow well, for the northern winters were too cold and the southern summers too humid. Later,



Gerald R. Massie

Juicy, Purple Concord Grapes grow in many parts of the United States. The vines usually climb on wire trellises.

growers found that the vines would thrive in California, and started vineyards there. Thus they established one of the most important grape-producing regions of the world. Grapes for eating, found in stores in the United States throughout the year, usually are vinifera grapes from California. Some important table varieties are Emperor, Thompson Seedless, Flame Tokay, and Ribier.

North American Grapes grow so profusely and there are so many varieties that the continent has been called "a natural vineyard." Growers have crossed many of these wild types with the vinifera to get varieties that thrive in North America where the true vinifera will

not grow. These grapes are called *American* varieties.

The *fox*, or *labrusca*, are the best known of the American kind. The red Catawba used in wine making, the purple-black Concord, and the green Niagara varieties are typical American grapes. In the South, the native summer, or *aestivalis*, grape, combined with the introduced vinifera, produces varieties like Norton and Delaware. The *rotundifolia*, or *muscadine*, grape grows wild in the South. The *Scuppernon* variety is well known.

Growing Grapes

Grapevines may spread as much as 100 feet. Growers call the main stem the *trunk*, and the main branches the *arms*. The soft green growths of the current season are called *shoots*. When the shoots become brown and lose their leaves in the fall, they are called *canes*. Grapevines develop leaves that are thin, rounded, divided, and usually large. Botanists classify the fruit as a berry. It may contain one to four seeds, or be seedless.

Cultivation. Cultivated grapes grow from cuttings made from canes. In winter, growers cut pieces of cane about 12 inches long. Each section has five or six buds. These cuttings are stored. Early in spring, workers plant the cuttings upright in nursery beds, leaving the tops exposed. These grow during the summer. The following spring, when growing has stopped, the vine is dug and the top and roots are pruned. Then the new vines are planted in the vineyard in rows 10 to 12 feet apart.

Because grapevines climb by means of tendrils like most vines, they need support. Growers build supports by placing stakes beside each vine and then stringing wires between the stakes along the entire row. Vineyards need cultivation because grapes will not grow well in sod. Every winter, growers prune the vines to keep them compact and to regulate the fruit they will bear. Each vine should bear from 15 to 25 pounds of grapes.

Enemies. A common insect pest, the *phylloxera*, destroys the roots of vinifera grapes (see PHYLLOXERA). But rootstocks of native American grapes resist this pest. Therefore, growers graft canes of whatever variety they desire on the resistant American roots. The leafhopper, grape-berry moth, and the grape rootworm attack the vines. The grape-berry moth makes grapes wormy. Four fungi that destroy grapes are powdery mildew, downy mildew, black rot, and anthracnose. Dusts and sprays control insect and fungus pests, except for phylloxera.

Harvesting. Grapes for the market are harvested by hand when they are ripe. Workers pick each bunch from the vine, being careful to touch the fruit as little as possible. They handle the bunches only by the main stem. The pickers place the bunches in wide, shallow boxes. Redwood chips protect the grapes from being bruised during shipping. Wooden protectors, placed between the boxes, keep the grapes from being crushed.

Grape-Growing Regions. France, Italy, Spain, and Germany produce grapes chiefly for wine. California produces all the raisins and 90 per cent of the wine made in America.

Scientific Classification. Grapes belong to the grape family, *Vitaceae*. European grapes are genus *Vitis*, species *vinifera*. American grapes are *V. labrusca*, *V. aestivalis*, *V. vulpina*, and *V. rotundifolia*. REID M. BROOKS

See also FARM LIFE (color picture, Picking Grapes); GRAFTING; PRUNING; RAISIN; WINE.

GRAPE SUGAR. See GLUCOSE.

FOUR LEADING GRAPE STATES AND PROVINCES

California.....	2,612,500	               
New York.....	88,900	
Michigan.....	44,800	
Ontario.....	41,000	

Each symbol  stands for 100,000 tons of grapes grown.
Based on government statistics for a 4-year period.



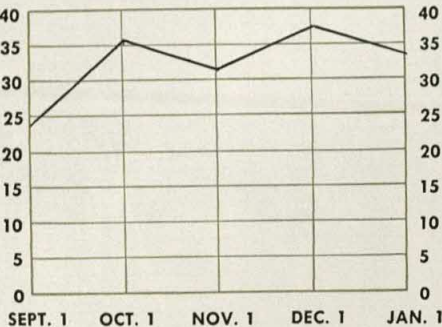
A black and white photograph capturing a moment of manual labor in an orchard. A man, wearing a light-colored long-sleeved shirt, dark trousers, and a cap, is perched on a tall wooden ladder. He is reaching into the dense canopy of a large orange tree, which is heavily laden with ripe fruit. Below the ladder, a long, low wooden cart is filled to the brim with harvested oranges. The cart has a single large, treaded tire visible on the left side and is parked on a dirt path. The scene is set outdoors, with the bright sunlight creating strong shadows and highlighting the texture of the leaves and the round shapes of the oranges.

ROBERT WILLARD HODGSON

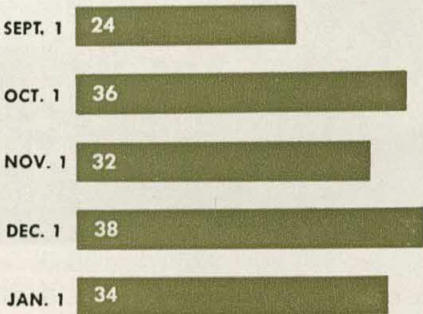
313

GRAPH

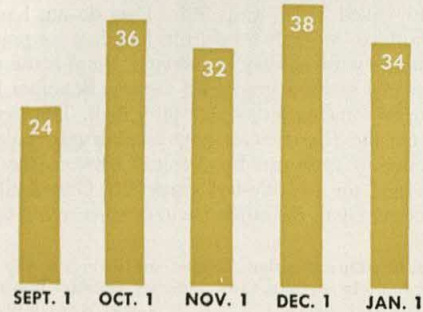
NUMBER OF PUPILS PRESENT



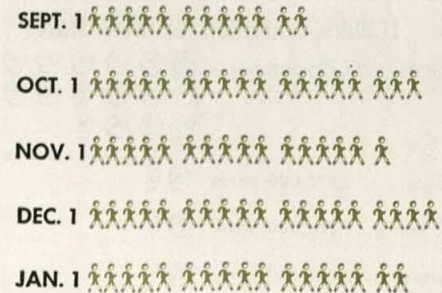
Graph 1



Graph 2



Graph 3



Each symbol represents 2 pupils present

Graphs: Pictograph Corporation

Graph 4

GRAPH is a drawing showing the relative sizes of numerical quantities. It is used to present facts in picture form so that they will be clearer and easier to understand. For example, we have a record of the number of students present in a classroom on the first day of each of five different months. On September 1, 24 pupils were present; on the first of October, 36; and on the first of November, 32. On December 1, 38 were there; and on January 1, 34. Graphs 1 through 4 show four different ways of representing these facts.

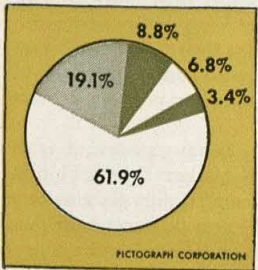
The Line Graph is the simplest type, and one of the easiest ways to show the relative number of pupils present. It is illustrated in Graph 1.

Line graphs are made by drawing lines at right angles to each other. One of these lines is used to show the number of pupils present, the other for dates. Points on the drawing indicate how many pupils were present on each date listed. These points are then connected by a line in the order that the dates appear. This type of graph can be used for many kinds of facts, such as the grades a pupil makes on certain days, or the amount of production of factories or farms at given times. It can also be used to indicate statistics of income, taxes, and wealth, as well as athletics, trade, and population.

The Bar Graph is of two kinds. It can be used to illustrate the same kind of facts that the line graph shows. For instance, Graph 2 is a horizontal bar graph of the enrollment in school on a certain date. The bar graph is a good way of expressing comparisons of increases and decreases in quantity over a period of time. Graph 3 has the same kind of a bar graph, but in this case it is a vertical bar graph.

The Picture Graph uses symbols instead of lines or bars to make its point. The pictorial form makes it easier for the reader to grasp the idea represented. It is most often used in magazines and newspapers to convey information to casual readers who haven't time to examine lists of figures. This type of graph, which has gained popularity in recent years, actually originated in the pictographs used by primitive people. It was the earliest form of writing. The picture graph is illustrated in Graph 4. In this case, each symbol represents two pupils present.

The Circle Graph shows the relation of the parts of anything to the whole. For example, suppose the cost of education in a country was \$2,000,000,000 and this sum was divided as follows: general control, 3.4 per cent; instruction, 61.9 per cent; operation, maintenance, and auxiliary agencies, 19.1 per cent; capital outlay, 8.8 per cent; interest, 6.8 per cent. If a circle graph is used, as in Graph 5, these percentages may appear as wedges such



Graph 5

as pieces of a pie. For this reason, these graphs are often called *pie charts*.

Many other types of graphs picture a wide range of subjects. The simpler graphs generally make facts plain rather than give statistics.

See also ALGEBRA (Functions); CHART; PICTOGRAPH; STATISTICS.

RUDOLF MODLEY

GRAPHIC ARTS is a general term applied to the arts of printing, engraving, etching, lithography, and *serigraphy*, or silk screen printing. Painting and drawing are sometimes included.

After the invention of printing, men could produce large numbers of copies of books and pictures. They no longer had to copy them laboriously by hand. But the invention of printing did not put an end to the skill and art that had gone into *illuminated* manuscripts, which the monks had illustrated with beautiful illuminations, or colored pictures. Printers followed the traditions of the monks, and turned out books of great beauty of design and binding.

Artists who had copied the works of the masters turned from pen and brush to etching and engraving in metal, so that their pictures could be printed in large numbers. They began to use lithography after 1796, and even greater numbers of pictures could be printed. Photography and bookmaking are important outgrowths of the work of earlier printers, engravers, artists, craftsmen, and scientists.

HARRY A. BROADB

Related Articles in WORLD BOOK include:

Advertising	Illustration	Photoengraving
Block Printing	Intaglio	Photography
Bookbinding	Lithography	Printing
Engraving	Manuscript	Silk Screen Printing
Etching	Paperwork	Woodcut
Half-tone	Decorative	

GRAPHITE, *GRAF ite*, is a crystalline form of pure carbon which is used in all "lead" pencils. Graphite was once mistaken for lead, and it is sometimes called *black lead*, or *plumbago*. The substance was named graphite in 1789 by Abraham Werner, a German geologist. The name comes from a Greek word meaning *to write*.

Graphite is one of the softest known minerals. It is a wonder of nature that this greasy black material is the same chemical substance as the hardest known mineral, the diamond. When diamonds are heated to 3,452°F. in the absence of air, they turn to graphite. Meteorites contain a kind of graphite called *cliftonite*, which has been formed in this way.

Where It Is Found. Graphite is found in meteorites and in sedimentary, igneous, and metamorphic rocks. The metamorphic rocks contain the most valuable commercial deposits. There are many theories explaining how graphite is formed. Some of this material is believed to be formed from carbon dioxide (CO₂). Geologists believe that in most cases the carbon came from organic matter such as coal or petroleum.

Graphite was known in Ceylon as early as 1675, and was brought from there to the United States in 1827. Some of the best graphite is still mined in Ceylon. Graphite deposits occur in 25 states in the United States. Seventeen of these states mine graphite in commercial quantities. One of the first mines in the United States was at Ticonderoga, N.Y. It produced graphite from 1850 to 1918. Little graphite is produced regularly, however, and the United States imports far more than it produces. Most of the graphite imported by the United States comes from Malagasy (formerly Madagascar), Mexico, and Canada. Among important graphite producers are Austria, Ceylon, Norway, and Korea.

Kinds of Graphite. After natural graphite has been mined, it is ground and then purified in settling tanks. Two kinds are marketed commercially. They are called

crystalline and *amorphous* graphite. The amorphous form is also crystalline, but it has a finer grain.

Artificial graphite has been made since 1896, when the process was discovered by Edward Acheson. At Niagara Falls, the center of this industry, powerful electric currents reproduce processes in a few minutes which take millions of years in nature. Coal or coke is made to yield graphite. Manufactured graphite can now be substituted for almost all the uses of natural graphite.

Graphite was first used in pencils in 1550, but it has many other uses. Its softness and greasiness make it useful in manufacturing paints and lubricants.

A. PABST

See also ALLOTROPY; CARBON; DIAMOND; PENCIL; POWDER METALLURGY.

GRAPHOLOGY, *graf AHL oh jih*, is a method used to analyze character, personality, and health from handwriting. It is practiced by graphologists in many parts of the world, although there is no scientific proof that the interpretations of graphology are correct.

Graphology as it is ordinarily practiced is classed as a *pseudo*, or imitation, science. Some of the facts on which it is founded are true. For example, a person's handwriting does change in old age, during illness, or when he is under great emotional strain. But the graphologists draw broad conclusions from such simple facts and treat them as scientifically proved. For example, people who write in lines that slant upward are said to have ambition. Those whose lines slant downward are said to have pride. Heavy lines and thick strokes in crossing t's are supposed to show power and force.

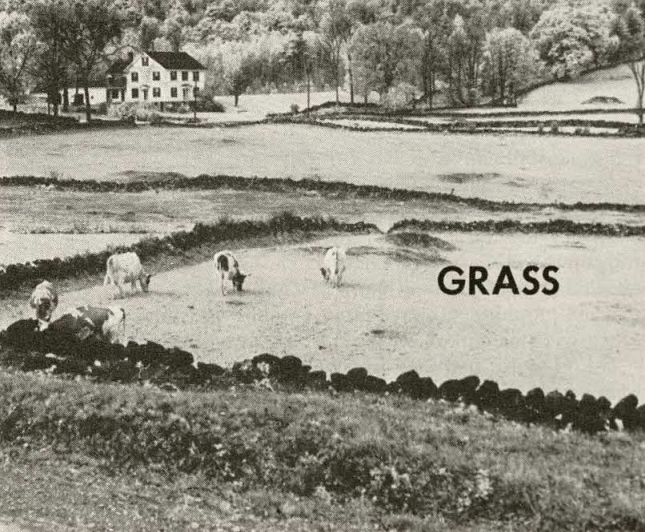
When the a's and o's are closed, the writer is supposed to be a reserved, quiet sort of person. If the writer uses fine lines, he is said to be timid or bashful. All graphologists would not agree with these interpretations. Reasonable opinions, guesses, and the techniques of fortunetelling make up the "science" of most graphologists. See FORTUNETELLING.

Some psychologists have studied graphology to see if anything could be learned from it about personality analysis. Alfred Binet, the famous French psychologist, once tested seven graphologists. He gave them the handwriting of 37 men who had been highly successful in life, and 37 men from the same social level who had not been outstanding. He asked the graphologists to tell which handwriting belonged to the famous men. None of the graphologists made as low an average as 50. One of them was 92 per cent right, and the others made grades of 86, 83, 80, 68, 66, and 61.

Although this test indicated that graphology may contain some valuable truth for science, its principles have never been proved decisively. At the University of Wisconsin some years ago, the principles of several leading graphologists were applied to the writing of 17 students. Then the students were asked to rate each other according to the pride, ambition, and other qualities which they had observed in each other. The scientists found no relation between the social personalities of the students and what their handwriting said of them.

Scientists believe, however, that when more thorough scientific studies are made of handwriting, something may be learned from graphology. But at best it will give them only a small amount of knowledge about personality, health, or character.

JOHN MULHOLLAND



USDA

GRASS. The grass family of plants is remarkable because its members grow in almost all places and include many different forms. The grasses rank first among all families of the plant kingdom in their usefulness to man.

Many people ask the question, why is grass green? Grass and other green plants get their color from chlorophyll. This pigment helps change sunlight into energy used by the plants. See **CHLOROPHYLL**.

The Grass Plant

Some grasses are heavy-stemmed, and grow much higher than a man's head. Bamboo and sugar cane are among these giant grasses. Others grow only a few inches tall, or so slender that their dying stems look like golden threads. Some grasses are stiff enough to stand up even under a load of snow.

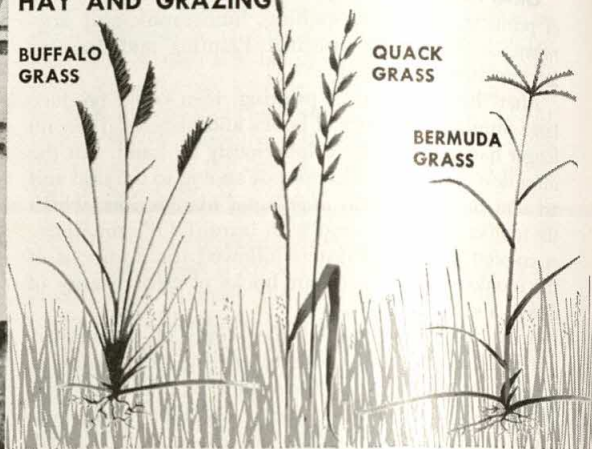
Grasses are flowering plants. Their individual flowers are relatively simple in shape. They are usually grouped into spikes, or *panicles*. There are so many different forms of these arrangements that grass flowers are a delight to plant lovers. In some grasses the panicles of flowers are over half a yard long. All grasses have fibrous roots, and nearly all have hollow, jointed stems.

GRASSES USED FOR HAY AND GRAZING

BUFFALO GRASS

QUACK GRASS

BERMUDA GRASS



The arrangement of the leaves on the stem is called *two-ranked*. That is, each leaf grows on the opposite side of the stem from the one below it. This brings the third leaf directly above the first, and the fourth above the second. Grasses grow in every kind of land and climate—in dry bare places, in moist rich soil, in marshes, in stagnant water, and on inland prairies.

The great grass family includes about 4,700 species. Nearly 1,000 species grow in the United States and Canada. The grasses include the great cereals of the world—wheat, corn, oats, rye, barley, and rice, which provide man with the most important part of his vegetable food. Most grasses are herbs, but the treelike species, such as the bamboos, have woody stems. Bamboos are among the most useful of all plants. Sugar cane, another member of the grass family, furnishes the world with about two thirds of its sugar.

The meadow and pasture grasses provide valuable food for farm animals. The principal pasture grasses include redtop, bluegrass, bent, and Bermuda grass. The hay grasses include redtop, bluegrass, timothy, tall oat grass, and rye grass. Important grasses of the western range of the United States are crested wheat grass and

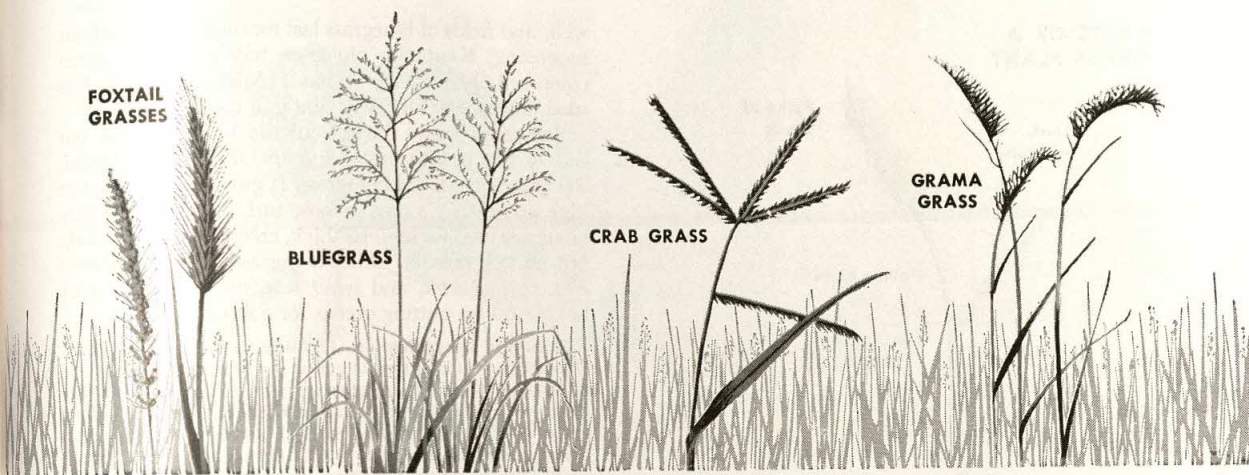


Merion Bluegrass forms a dense turf that resists drought and hard wear. Its deep roots and heavy rhizomes speed recovery after injury. It makes an excellent lawn.

Fred Grau

A Mixture of fine-bladed grasses, *right*, containing a high percentage of bluegrass, grows well on the West Coast. It thrives in either sun or shade. Kentucky bluegrass, *far right*, also makes an excellent grass for lawns. It has long, narrow leaves and bluish-green stems. This type of sod-forming grass is often used on golf courses.

Ferry Morse Seed Co.



buffalo grass. Grasses used extensively to beautify lawns, landscapes, and golf courses include bluegrass, bentgrass, rye, and fescue (see **LAWN**).

Common Grasses

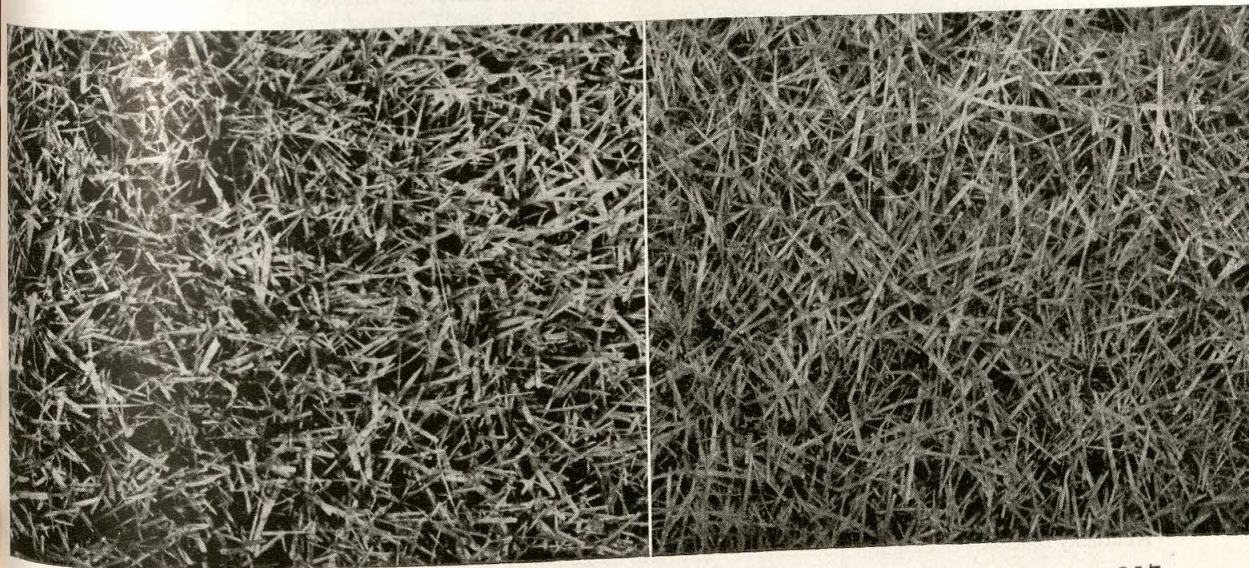
Couch Grass is a common grass or weed that looks somewhat like wheat. Couch grass is also known as *quick grass*, *dog grass* and *wheat grass*. Another name is *quack grass*, because its roots are often used in patent medicines. The stems that bear the seeds grow 1 to 4 feet tall, and the leaf blades are 3 inches to a foot long. This grass is one of the worst weed pests in the northern United States and southeastern Canada. The tough underground stems, or rootstocks, spread far out. Often they pierce the roots of other plants. The seeds grow in spikelets. They are likely to become mixed with grain seed and make it less valuable. Sheep like couch grass when it first comes above ground. It makes good hay, but it is a pest when it grows on cultivated ground. The matted roots of a growth of couch grass are useful in holding together the loose soil of railway embankments.

Foxtail. The flowers of foxtail grow in long thick clusters that look somewhat like a fox's tail. The various

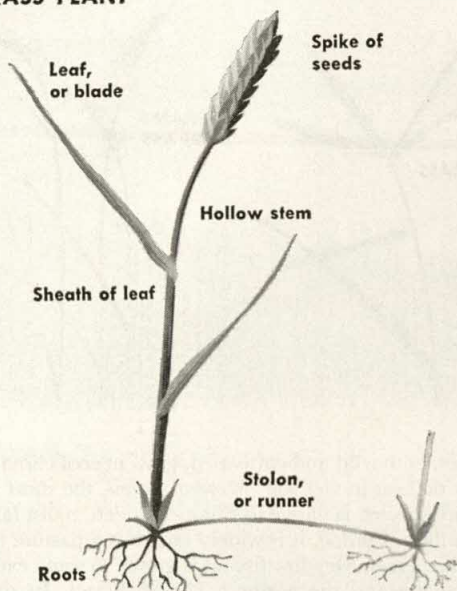
species, both wild and cultivated, grow in cool climates. They do best in wet soil. *Meadow foxtail*, the most important species, is native to Europe. In rich, moist lands of northern Europe, it is widely raised as a pasture and meadow grass. Meadow foxtail is grown to some extent in Canada and the northern United States. In these countries, it is less important than bluegrass, timothy, and some other hay grasses. Foxtail is sometimes planted as a lawn grass.

Another foxtail group includes chiefly weeds. These are troublesome in the grain-growing regions of the United States and Canada. Farmers must control these weeds in order to protect their crops. The useful *foxtail millet* and the harmful weeds are both members of the same genus (see **MILLET**).

Teosinte is a perennial grass often used as fodder for livestock. Of the wild grasses, it is considered the nearest relative of maize, or Indian corn (see **MAIZE**). It grows wild in most soil from Connecticut west to Kansas and south to Florida and Texas. This grass can live through drought, but is quickly killed by frost. Its coarse, pithy, branching stems grow from stout rootstocks and reach a height of 9 or 10 feet. The leaves are



PARTS OF A GRASS PLANT



about 6 feet long and resemble those on a stalk of corn. In midsummer the grass bears spikes of feathery, dark purple flowers, topped with long orange anthers. Teosinte makes tasty hay if cut when young, but the older stems are woody.

Bermuda Grass. This grass is also called *scutch grass*, *dog's-tooth grass*, and *Bahama grass*. In Bermuda it is known as *devil grass*, and in India as *doob*. It originally grew in Europe, but has spread to many warm countries, including the Americas. Bermuda grass grows in fields and in places where few other plants thrive. It sends up erect stems, 4 to 12 inches tall, from long runners that branch on the ground. The smooth, stiff blades of this grass are an inch or two long. Its spikes of flowers grow in groups of four to five. In the southern United States and India, this grass is raised on lawns and in pastures.

Buffalo Grass. Buffalo grass grows on the western ranges of the United States, where bison used to graze. It now serves as food for herds of cattle. Buffalo grass also binds the soil, preventing erosion.

Crab Grass includes several kinds of grass with stems that lie or creep along the ground. These stems send off roots and make the grass a harmful weed in land where crops are growing. *Yard grass*, however, is a crab grass that is cultivated in places like dooryards. Other crab grasses are called *finger grasses*, because their seed spikes grow in groups like fingers.

Grama Grass occurs mostly in the Great Plains and the Western States. One of the most common grama grasses is *blue grama*. The stems grow from 12 to 18 inches tall, and have leaves from 3 to 6 inches long. Blue grama makes excellent forage, or food for livestock. It is also widely used in conservation to prevent soil erosion.

Bluegrass is among the most valuable grasses. About 65 species are native to the United States. They are used for pasture, hay, and lawns. *Kentucky bluegrass* is one of the most familiar types of bluegrass. It grows from 18 to 24 inches tall, and sometimes as high as 36 inches. Kentucky bluegrass is a durable perennial. It takes root

well, and fields of bluegrass last for many years without re-seeding. Kentucky bluegrass has an intense green color, but *Canada bluegrass* has a bluish-green color. It is used extensively for lawns and golf courses.

Bentgrass grows throughout the United States, but thrives best in temperate climates. *Redtop*, a perennial, is a common type of bentgrass. It grows from 2 to 4 feet high and makes a coarse, loose turf. Redtop is the only bentgrass used for hay. Its thick, creeping roots also help prevent soil erosion. Other bentgrasses, such as *colonial bent*, *creeping bent*, and *velvet bent*, are widely used on lawns and on putting greens for golf courses.

Scientific Classification. Grasses make up the family *Gramineae*. Couch grass is genus *Agropyron*, species *repens*. Meadow foxtail is *Alopecurus pratensis*. Foxtail millet is *Setaria italica*. Bermuda grass is *Cynodon dactylon*. Buffalo grass is *Buchloe dactyloides*. Crab grass includes finger grass, yard grass, and Egyptian grass. Finger grass makes up the genus *Digitaria*. Yard grass is *Eleusine indica*. Egyptian grass is *Dactyloctenium aegyptium*. Grama grass makes up the genus *Bouteloua*. Bluegrass comprises the genus *Poa*. Bentgrass makes up the genus *Agrostis*. Rye grass is genus *Lolium*. FRANK THONE

Related Articles in WORLD BOOK include:

CULTIVATED GRASS

Barley	Maize	Rye
Broomcorn	Millet	Sorghum
Corn	Oats	Sugar Cane
Kafir	Rice	Wheat

FORAGE CROPS

Alfalfa	Clover	Soybean
Bent	Fescue	Timothy
Brome Grass	Kudzu	Vetch
Buckwheat	Rape	

WILD GRASS

Bamboo	Esparto	Sudan Grass
Bent	Reed	Wild Barley
Bluegrass	Sandbur	

UNCLASSIFIED

Grain	Herb	Sedge
Grassland	Lawn	Weed
Hay	Pasture	

GRASS LAKE. See ILLINOIS (Rivers and Lakes).

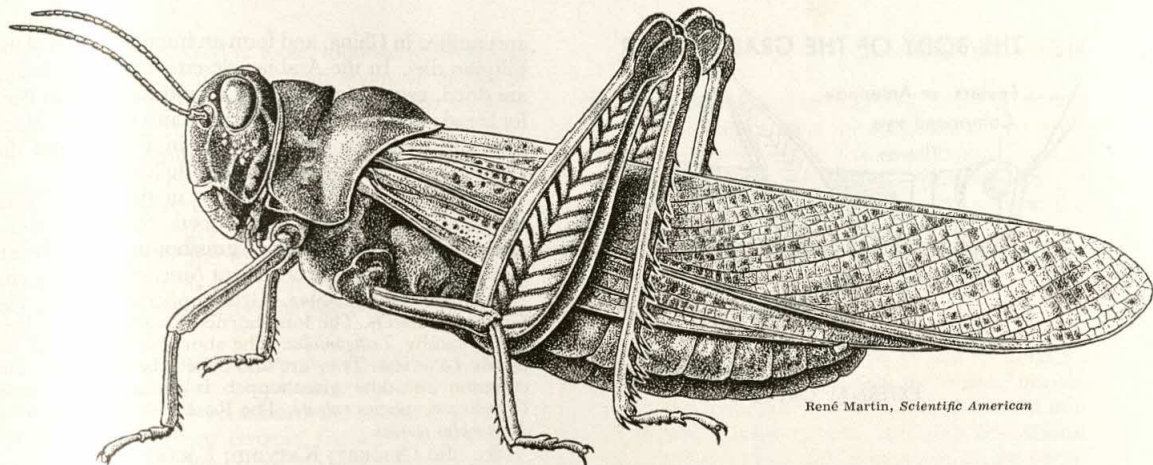
GRASS SKIRT, to most people, means the *hula skirt* worn by dancers in Hawaii. Actually, the custom and the skirt first appeared among the peoples of Polynesia. The hula skirt was originally worn in ritual dances honoring certain local gods. Most grass skirts are fairly short. They are made of plaited grasses or shredded ti leaves.

See also HAWAII (Dancing).

GRASS WIDOW is a term often given to a woman who lives apart from her husband either because of divorce or separation, or because of his absence, as in war.

GRASSE, grahs, FRANÇOIS JOSEPH PAUL (1722-1788), COMTE DE GRASSE, a French admiral, aided General George Washington at the siege of Yorktown in the Revolutionary War. He commanded the French fleet that drove the English Navy away from the Virginia coast and cut off General Charles Cornwallis from aid or retreat (see REVOLUTIONARY WAR IN AMERICA [Surrender at Yorktown]). Grasse later was defeated and captured by the British in the West Indies. He returned to France in disgrace. Grasse was born near the city of Toulon, France.

RAYMOND O. ROCKWOOD



The Grasshopper's Amazing Hind Legs Enable It to Leap 20 Times Its Own Length.

GRASSHOPPER is the common name given to two types of leaping insects. Grasshoppers include all the insects commonly called locusts, but not all grasshoppers are locusts. The main difference between locusts and other grasshoppers lies in the length of the feelers or *antennae*, sometimes called "horns." Locusts have shorter antennae than grasshoppers.

Grasshoppers leap through fields and meadows and along dusty roadsides all summer long. They have long, slender hind legs with large thighs. These make it possible for them to jump distances many times their own length. They can jump 10 times as high as their own body length, and 20 times their length horizontally. If a boy could jump as far in proportion to his size as a grasshopper can, he could jump over a barn. Many kinds of grasshoppers have no wings, and some have only short wings. But most grasshoppers have large, delicate hind wings. These wings are straight and powerful.

Grasshoppers usually fly only short distances, but they have been known to fly high in the sky when in search of food. When the hind wings are folded in at rest, they are protected by thick, tough front wings that sometimes extend beyond the abdomen.

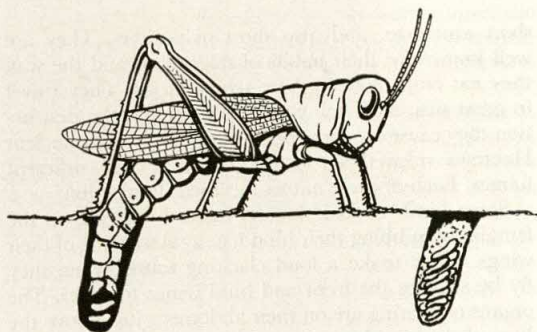
Long-Horned Grasshoppers are the green grasshoppers that live in meadow grass and hedges. Children who live in the country often like to catch them in their hands and see them leap when they are set free. Their antennae are curved and threadlike, and much longer than the bodies of the insects. Grasshoppers belong to the same family as the katydids, which live in trees. When grasshoppers are in danger they "spit" out a brown liquid that children call "tobacco juice." They take long leaps when they try to escape. Their green color helps conceal them in the grass.

Male long-horned grasshoppers "sing" by rubbing the bases of their wings together. Long-horned grasshoppers hear with their legs. The hearing organs, or "ears," of both sexes form on little growths just beneath the knee joint on their front legs. The female has, at the end of the abdomen, an *ovipositor*, or long growth shaped like a sword or sickle. The female uses the ovipositor to drill holes in grass, twigs, or in the ground. She deposits her eggs in these holes.

The young grasshoppers have a pale, delicate color.

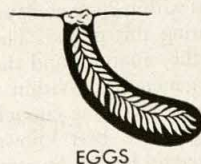
They have no wings when hatched. The wings begin to develop in about two weeks and enlarge each time the grasshopper changes his skin, or *moult*s. But the wings do not reach full size until the insect is grown. Meadow grasshoppers eat pieces out of tender leaves and stems, but usually do not harm the farmer's crops.

Short-Horned Grasshoppers. The insects known as locusts are really short-horned grasshoppers. They have

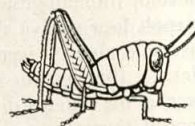


Cornelia Clarke

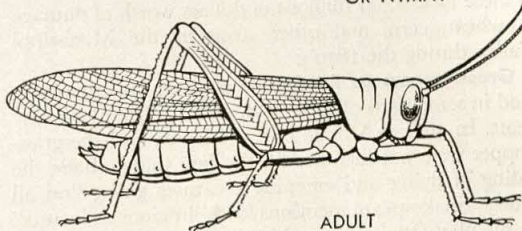
An Adult Female Grasshopper lays eggs in a hole drilled in the ground by a special organ. Grasshoppers lay from 25 to 125 eggs at one time. The eggs are covered with a sticky froth that holds them together in a podlike mass until hatched.



EGGS



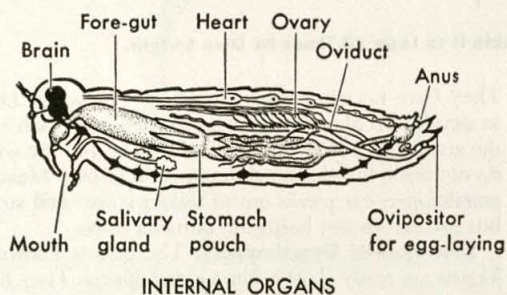
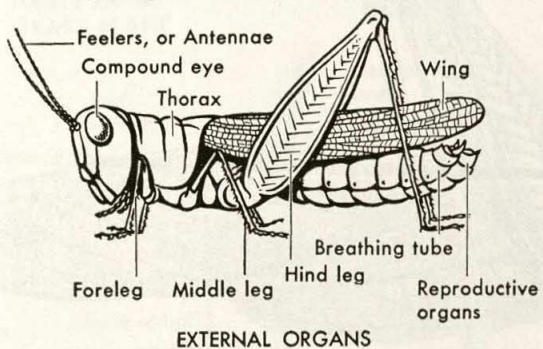
YOUNG GRASSHOPPER,
OR NYMPH



ADULT

Stages of the Life History of the Grasshopper.

THE BODY OF THE GRASSHOPPER



short antennae, and also short ovipositors. They are well known for their habits of migration, and the way they eat crops and lay bare whole farms. They travel in great swarms. Their great numbers and the destruction they cause are mentioned in the Bible. The ancient Hebrews referred to locusts under several different names. Each of these names signified destruction.

Some kinds of male locusts make loud calls to the females by rubbing their hind legs against parts of their wings. Some make a loud clacking sound when they fly by striking the front and hind wings together. The organs of hearing are on their abdomens just above the base of the hind legs.

Like the young of long-horned grasshoppers, the young locusts, or *nymphs*, look like the adults, but have no wings. The eggs are laid below the ground, usually in the fall. The nymphs, or larvae, hatch in the spring and develop into full-grown locusts within 80 or 90 days. They molt four or five times during this period. The insects mate about a week after they mature, and the females lay the eggs for another generation. Within a few weeks, the parents die. But some live long enough to deposit several masses of eggs. The best known American locust is the *Rocky Mountain* locust. Swarms of these locusts did millions of dollars worth of damage to wheat, corn, and other crops in the Mississippi Valley during the 1870's.

Grasshoppers as Food. The locust is an important food in some parts of the world, and has been for many years. In ancient Mosaic law, the locust and the grasshopper were not included in the law that forbade the eating of flying and creeping creatures going "on all fours." Shakespeare mentions food "luscious as locusts" in his play *Othello*. Saint Matthew said that John the Baptist's meat was "locusts and wild honey." Locusts

are candied in China, and form an important part of the Filipino diet. In the Arabian deserts, the insect bodies are dried, ground into a powder, and mixed with flour for bread. This is also done in the plains of North Africa near the Red Sea. Some people in Europe and the United States eat grasshoppers as delicacies.

In North America, the Indians in the Great Plains region enjoyed roasted grasshoppers. Some archaeologists believe that plagues of grasshoppers and locusts may explain migrations of ancient American civilizations.

Scientific Classification. Grasshoppers compose two families of insects. The long-horned grasshoppers belong to the family *Tettigoniidae*. The short-horned are in the family *Locustidae*. They are also called the *Acrididae*. The common meadow grasshopper is classified as genus *Orchelimum*, species *vulgare*. The Rocky Mountain locust is *Melanoplus spretus*.

CARL D. DUNCAN

See also CRICKET; KATYDID; LOCUST.

GRASSLAND is one of the four chief kinds of natural vegetation. The other three types are forest, desert shrub, and tundra. Most grasslands lie between very arid lands, or deserts, and humid lands covered with forests. Some grasslands occur in humid climates.

The three types of grasslands are (1) steppes with short grasses, (2) prairies with tall grasses, and (3) tropical savannas with coarse grasses. The word *steppe*, derived from a Russian word meaning *grassy plain*, designates semi-arid grasslands in all parts of the world. Well-known steppes include the Great Plains of North America, the Dry Pampa of Argentina, and the Velde of South Africa. In the driest parts of the steppes, grasses are short and occur as scattered bunches with bare ground between them. On the humid margin, the grasses grow taller and are more closely spaced. See PAMPAS; STEPPE.

Prairies are grasslands in humid climates, often occurring with patches of forests. Large prairies include much of the American Midwest, the Pampa of eastern Argentina, and the basins of Hungary and Manchuria. See PRAIRIE.

Tropical savanna areas have a dry season in winter and a rainy summer. They include the Llanos of Venezuela, the Campos of southern Brazil, and the Sudan of Africa. See LLANOS; SAVANNA.

Many of the world's grasslands are used for grazing both wild and domestic animals. Grasslands are also used for farming. The chief grassland crops are wheat on the steppes, corn on the prairies, and sugar cane and rice on the savannas.

SAMUEL N. DICKEN

See also PASTURE.

GRASSMANN, HERMANN. See FOURTH DIMENSION.

GRATING. See DIFFRACTION.

GRATTAN, HENRY (1746-1820), an Irish statesman and orator, worked to free the Irish Parliament from the English Privy Council, to free Irish commerce from heavy restrictions, and to give voting rights to Roman Catholics. His efforts were partly successful until the Act of Union (1800) abolished the Irish Parliament. Grattan then became a member of the British House of Commons (see IRELAND [In the 1700's]). Grattan was born in Dublin, and was educated at Trinity College there. He later was admitted to the bar. In 1775, he was elected to the Irish Parliament.

JAMES L. GODFREY

GRATUITY. See TIP AND TIPPING.

GRAU SAN MARTÍN, RAMÓN. See CUBA (Independence).

GRAVEL is composed of loose, rounded mineral and rock fragments that measure from about an eighth of an inch to a foot or more across. Geologists identify small fragments in gravels as *granules* or *pebbles*, medium-size fragments as *cobbles*, and large chunks as *boulders*. Most of the useful deposits of gravel were laid down by streams or were formed in lakes or along seashores. Gravel pits also have formed in the past by deposits from moving and melting glaciers. Gravel mixed with sand and clay is dug from the earth out of gravel pits. Screens are used to sort the gravel for size after it is washed.

Construction companies use great quantities of gravel to build roads, railroad embankments, and landing strips on airfields. Paved surfaces are made with gravel mixed with asphalt or cement. Gravel is mixed with sand, water, and cement to make concrete used in buildings, bridges, and dams. The mixture of sand and gravel found in concrete is called *aggregate*. For most purposes, aggregate must contain only fresh, hard rock fragments, and no clay.

Large amounts of gravel are found and dug in every state. The United States produces more than 250,000,000 tons of gravel a year.

ERNEST E. WAHLSTROM

See also CEMENT AND CONCRETE (Materials); ROCK (Clastic Sediments).

GRAVENHAGE, officially 's GRAVENHAGE. See HAGUE, THE.

GRAVES, ROBERT (1895-), is an English novelist, poet, and critic. He earned his living with his historical novels, but his chief concern always was poetry. One of his best-selling historical novels, *I, Claudius* (1934), tells the story of imperial Rome. A sequel, *Claudius the God*, also appeared in 1934. *Goodbye to All That* (1929; revised 1957) is a stirring and outspoken record of the ordeal of Graves' generation during World War I. Among his more important nonfiction books are *A Survey of Modernist Poetry* (1927), written with the American poetess Laura Riding; *The White Goddess* (1948); and *The Common Asphodel* (1949). Graves was born in London. He was graduated from Oxford University in 1926.

R. W. STALLMAN

GRAVES, ROBERT JAMES (1796-1853), an Irish doctor, reported in 1885 on the thyroid gland disease known as *hyperthyroidism*, or exophthalmic goiter. Since then, the condition has also been called Graves' disease (see THYROID GLAND). Graves was chiefly interested in acute communicable diseases, and insisted, against common practice, that patients with fevers be well fed. One day, while passing through a ward of typhoid fever patients, he remarked that his epitaph might be, "He Fed Fevers." Graves was an excellent teacher, and wrote the textbook, *Clinical Lectures on the Practice of Medicine* (1848).

He was born in Dublin, the son of a distinguished clergyman. He received his medical degree from Dublin University in 1818, and studied later in Europe. Graves was skilled at learning languages. He was held in prison in Austria for 10 days as a German spy, because authorities refused to believe an Irishman could speak German as well as he did.

GEORGE ROSEN

GRAVEYARD OF THE ATLANTIC. See SABLE ISLAND.

GRAVIMETER, instrument used in oil exploration. See PETROLEUM (Analyzing Earth Conditions).

GRAVING DOCK. See DRY DOCK.

GRAVITATION

GRAVITATION, *GRAV uh TAY shun*, is the attraction that masses of matter have for each other. The sun's gravitation holds the planets in their paths. Gravitational attraction between heavenly bodies holds the stars to their courses. The moon's gravity pulls at the oceans and causes the tides to rise and fall.

Gravitation is the force that holds the universe together. Gravity is the same thing. But we use the word *gravity* to mean particularly the attraction of the earth for small objects near its surface. When someone holds a heavy object in his hand, it seems to pull his hand toward the floor. When he releases the object, gravity makes it fall down to the earth instead of upward into the air. It allows people to walk, because it acts against the force of their steps, and holds them to the earth. Without gravity, an individual could spring from the earth and move upward until he bumped into some other object. If gravitation could suddenly be turned off like an electric light, the universe would come apart.

Newton's Law of Gravitation. In 1687, Sir Isaac Newton stated a universal *law of gravitation*. He said that all objects attract each other, and that the force of their attraction depends on the sizes of the objects and the distance between them. The force of attraction is in *direct* proportion to the product of their masses. The larger the bodies, the greater the attraction. The force is also in *inverse* proportion to the square of the distance between the two centers of mass. The farther apart the objects are, the less the gravitation is. But no matter how large or small any bodies of matter are, gravitation acts between them.

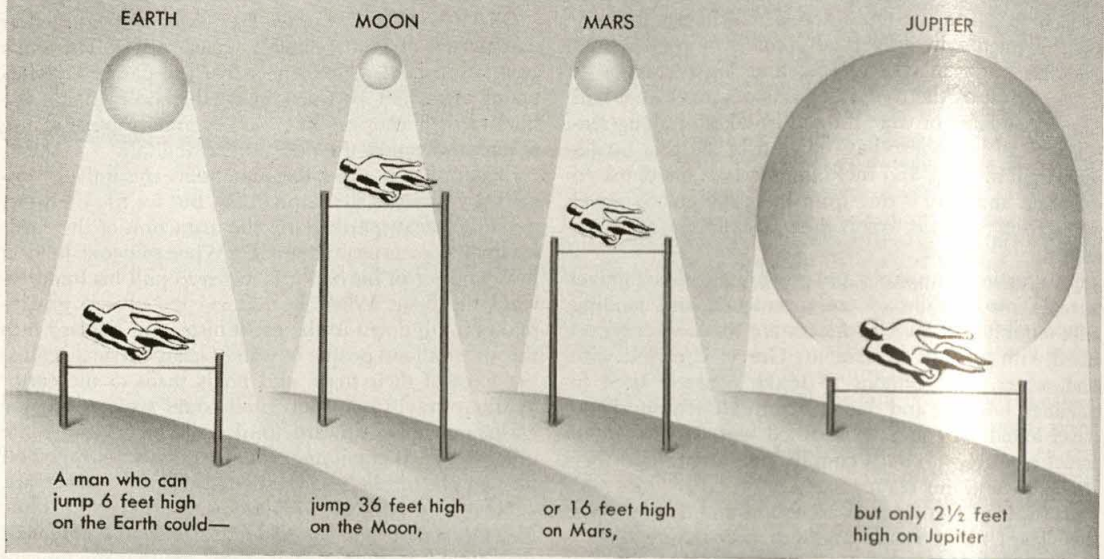
The law refers to mass instead of weight because the weight of a body on earth is really the particular strength of the earth's gravity on that body. On a different planet, the same body would have a different weight, but its mass would always be the same. For example, anyone would weigh six times as much on earth as he would on the moon. The moon has a smaller mass than the earth, and therefore it creates less gravitation.

Newton's law applies only to bodies that are outside each other. If a pound of mass is buried below the earth's surface, for example, it would be drawn toward the earth's center. But the force of attraction in this case would be in *direct* proportion to the distance from the earth's center. The closer the object is to the center of the earth, the less the attraction is.

Newton and Einstein. In 1916, Albert Einstein announced his theory of relativity. Four years later the proof of his theory was announced. Many scientists thought that Einstein's theory proved Newton's theory of gravitation to be incorrect. Actually, Einstein only gave a different description of gravitation. One of his ideas on gravitation was proven in 1919 and again in 1922. Einstein said that objects do not attract each other by exerting a pull. Space, he said, is warped or curved near matter. The curvature is greatest near heavy bodies.

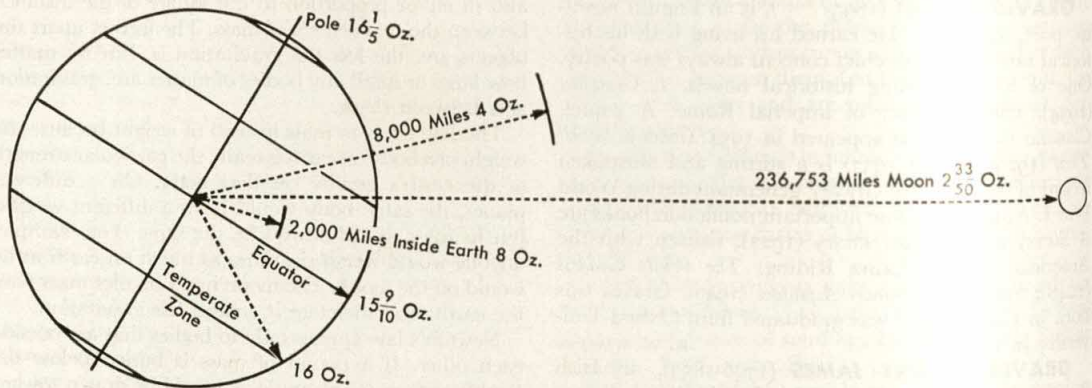
The particular curvature around any body is called the *gravitational field* of that body. The gravitational field of the sun is a kind of "hill" in space (which Einstein called *space time*). The sun is at the top of the hill. The planets and other bodies that move in the sun's gravitational field go around the sun instead of over it,

HOW GRAVITATION VARIES ON THE DIFFERENT HEAVENLY BODIES



Strength of Gravitation depends in part on the mass of an object. The larger an object, the greater its gravitation. This is

why a man who can jump 6 feet high on earth can jump 36 feet high on the smaller moon, but only $2\frac{1}{2}$ feet high on giant Jupiter.



Weight differs between the equator and the poles, because the polar diameter of the earth is 27 miles less than the equatorial diameter.

Gravitation depends partly on the distance between the centers of objects. The greater the distance, the less the gravitation. But when one object is inside another, gravitation decreases the closer their centers are to each other.

Related Articles in WORLD BOOK include:

Attraction
Einstein, Albert
Electromagnetism
Falling Bodies, Law of
Force
Gravity, Center of
Hooke, Robert

Neptune
Newton, Sir Isaac
Pendulum
Relativity
Torsion Balance
Weight

GRAVITY, CENTER OF, is the point where the whole weight of an object seems to center. It is the point on which an object will balance. Almost everyone has carried a long pole on his shoulder by holding it near the middle. This place is just below the center of gravity of the pole.

Gravity does not actually pull at this point alone. Any object is made of many bits of matter, and the

because the curved path is easier to take than the hill.

Einstein says that bodies do not attract each other at a distance. They merely follow the line of least resistance through the hills and valleys of the curved space that surrounds other bodies. Objects that fall to the earth, for example, are not "pulled" by the earth. The curvature of space time around the earth forces the objects to take the direction on toward the earth. The objects are pushed toward the earth by the gravitational field rather than pulled by the earth. See RELATIVITY (General Theory of Relativity).

No one yet knows the cause of gravitation. Newton did not try to answer that question. Einstein did not explain the cause either, although in 1929 he said that gravitation and electromagnetism might possibly be related.

ROBERT F. PATON

force of gravity pulls on every one of them. But the pull that would turn a board in one direction around its center of gravity is exactly as strong as the pull in the opposite direction. This turning power is called a *moment*. The moments are equal on opposite sides of the center of gravity.

The whole weight of body seems to pull in a line straight down from its center of gravity. An object that stands at an angle will fall over if this line falls outside its base. The leaning tower of Pisa is an example. This building tilts $16\frac{1}{2}$ feet off center, but remains standing. A plumb line dropped from its center of gravity would still fall inside the tower. An object that will stand is said to be *stable*.

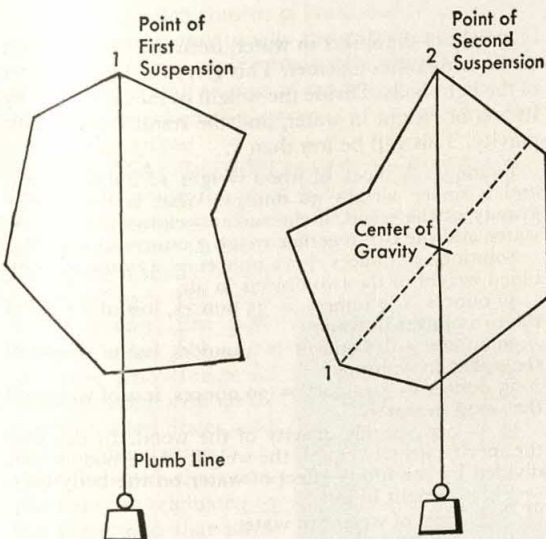
Gravity tends to pull a body to the position where its center of gravity is as low as possible. Then the body is said to be in *stable equilibrium*. A tilt to either side would only raise its center of gravity. If you balance a cone on its point, it is then in *unstable equilibrium*. A slight tilt to either side would lower its center of gravity, and it would fall to a more stable position. A cone on its side is in *neutral equilibrium*. Rolling it would neither raise nor lower the center of gravity. The higher the center of gravity of a body, the more easily it will tip over.

A center of gravity may be outside its object. This is true of many hollow objects, like boats or dishes. The point at which the sun pulls on the earth is not the center of the earth. It is the center of gravity of the earth and moon combined. The earth and moon do not form a single body, but their attraction for each other makes it impossible for the sun to pull on one without the other. They are like a dumbbell with one large and one small end.

Many textbooks now use the term *center of mass*, instead of center of gravity. This is because other forces besides gravity seem to act at this point when they act on the body as a whole.

ROBERT F. PATON

See also AERODYNAMICS (Gravity); FALLING BODIES, LAW OF.



To Find the Center of Gravity of an irregularly shaped plane object, suspend it first from one corner, and mark the line a plumb bob makes. Then suspend it from another corner. Where the two lines cross is the center of gravity.

GRAVITY, SPECIFIC

GRAVITY, SPECIFIC. The specific gravity of any material tells how its density compares with the density of water. *Density* is the weight of a standard volume of a material—usually a liter. But to find specific gravity, any other volume will do, so long as we use the same volume for the water and the other material. All we have to do is weigh the material in air, and then compare this weight with the weight of the same volume of water. For example, gold has a specific gravity of 19. This means that any volume of gold is 19 times as heavy as the same volume of water. The density of distilled water at 20°C .—sometimes at 4°C .—is the standard of comparison that scientists usually use to figure specific gravity.

Everybody knows that some substances are heavier than others. This difference gives them different specific gravities. It also provides a way to tell the different substances apart.

The Greek mathematician Archimedes discovered the facts of specific gravity. Hiero, the king of Syracuse in Sicily, once ordered a new crown of solid gold. After it was finished, the king suspected the goldsmith had alloyed the crown with silver and kept some of the gold for himself. To find out for sure, the king sent his crown to Archimedes.

Then one day Archimedes noticed that when he entered his bath he displaced some of the water, and it went spilling over the brim. Why not put the crown into a vessel filled with water, and measure how much spilled over? Then he would take the same weight of pure gold and put it into a vessel containing exactly the same amount of water. If the crown were also of pure gold, it would exactly equal the piece of gold in bulk. Both the crown and the gold would displace exactly the same amount of water, a volume that was equal to their own.

But silver is lighter than gold, so the same weight in silver would have to take up more space. If the gold in the crown were mixed with silver it would have a greater bulk than the piece of pure gold. It would then spill over a larger volume of water. Archimedes realized he had found his answer. The story says he was so excited he jumped out of his bath and without waiting to dress ran down the street crying, "I have found it!" By testing the crown in water, Archimedes found that the gold in it was impure.

Archimedes' Principle. Archimedes also noticed that bodies seem to be lighter when they are under water. Even heavy bodies that sink are easier to handle in the water. The force that seems to hold them up is called *buoyancy*. Archimedes' discovery about buoyancy is called *Archimedes' principle*. It says that when a body is placed in a fluid, the weight it seems to lose is equal to the weight of the fluid it displaces.

Archimedes' principle explains why some bodies float. When a body is even lighter than an equal volume of fluid, it will seem to lose all its weight when it has displaced only part of its own volume. At this point, it stops sinking.

Finding the Specific Gravity of a Solid. Archimedes' principle gives us an easy way to find the specific gravity of a substance. It is easy to see why this is so. When a body is completely under water, the volume of the

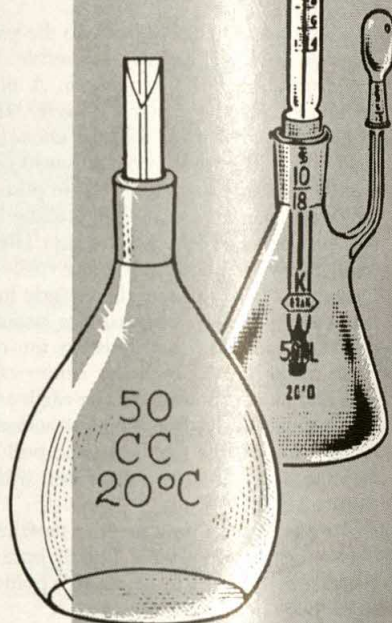
SPECIFIC GRAVITY



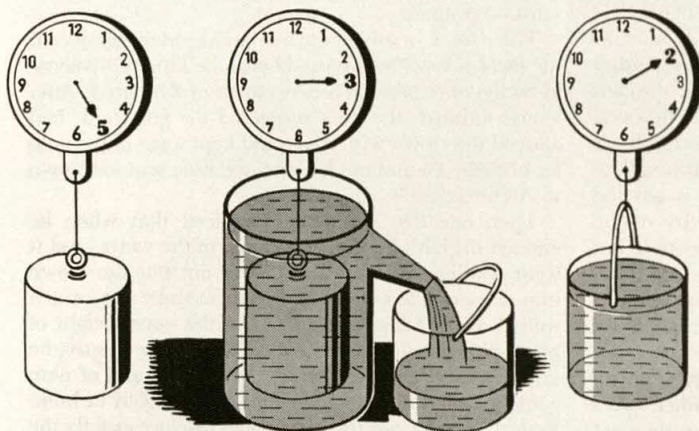
ARCHIMEDES
AND THE
KING'S CROWN

Archimedes discovered the facts of specific gravity when he was asked to find out if King Hiero's crown was actually made of solid gold. Scientists today use special bottles called *pycnometers*, right, to find the specific gravity of liquids.

TYPES OF
PYCNOMETERS



W. M. Welch Scientific Co.



To Find the Specific Gravity of an Object, compare its weight with the weight of the same volume of water. If the object weighs 5 pounds, and the amount of water it displaces weighs 2 pounds, then its specific gravity is 2.5.

water it displaces is equal to its own volume. The principle says that the weight of this volume is the same weight as that the body seems to lose. So the apparent loss can be used as the standard of comparison in finding the specific gravity of the body.

To find the specific gravity of a body heavier than water, first weigh the substance in air. Then weigh it in water. Subtract the weight in water from the weight in air. The result will be the weight of the water displaced. Divide the weight of the substance in air by its loss of weight in water, and you will have the specific gravity of that substance.

Example: A piece of metal weighs 17 pounds in air and 15 pounds when immersed in water. What is its specific gravity?

Solution. 17 pounds — 15 pounds = 2 pounds, the weight of an equal volume of water.

Since $S.G. = \frac{\text{weight of body}}{\text{weight of equal bulk of water}}$

$$S.G. = \frac{17}{2} = 8.5$$

To find the specific gravity of a body lighter than water, weigh the body in air. Then take a sinker heavy enough to keep the body under water, and weigh the sinker first in the air and then in the water. Then weigh both the body and the sinker in water. Subtract the loss

of weight of the sinker in water, from the loss of weight of the two bodies together. This gives the loss of weight of the light body. Divide the weight of the light body by its loss of weight in water, and the result is its specific gravity. This will be less than 1.

Example: A block of wood weighs 12 ounces in air, and a sinker weighs 30 ounces. What is the specific gravity of the wood, if the sinker weighs 25 ounces in water and the two together weigh 7 ounces in water?

Solution. 30 ounces + 12 ounces = 42 ounces, combined weight of the two objects in air.

42 ounces — 7 ounces = 35 ounces, loss of weight of the two objects in water.

30 ounces — 25 ounces = 5 ounces, loss of weight of the sinker in water.

35 ounces — 5 ounces = 30 ounces, loss of weight of the wood in water.

$\frac{12}{30} = 0.4$, specific gravity of the wood. In this case the specific gravity equals the weight of the body in air, divided by the lifting effect of water on the body only,

or $S.G. = \frac{\text{weight in air}}{\text{loss of weight in water}}$

Finding the Specific Gravity of a Liquid can be done without using Archimedes' principle. A specific-gravity bottle is commonly used. Scientists call such a bottle a *pycnometer*. It is made to hold a certain weight of water,

say a thousand grams. Fill the bottle with the liquid to be tested and weigh it. Divide the weight of the liquid in the bottle by the weight of water it is made to contain (1,000 grams). The result is the specific gravity of the liquid.

To find the specific gravity of a liquid without using a specific-gravity bottle:

A bottle weighs 300 grams when empty, 800 grams when full of water, and 675 grams when full of gasoline. What is the specific gravity of the gasoline?

Solution. 800 grams - 300 grams = 500 grams, weight of the water.

675 grams - 300 grams = 375 grams, weight of the gasoline.

$$\text{S.G.} = \frac{\text{weight of liquid}}{\text{weight of equal volume of water}} = \frac{375}{500} = 0.75.$$

The specific gravity of a liquid may also be found with a hydrometer.

The difference in the specific gravity of substances helps us to separate them from each other. One type of flotation separates materials in a liquid by allowing the lighter material to rise to the top. A cream separator works because of specific gravity. As the separator whirls, centrifugal force drives the heavier milk against a set of blades which direct it to a spout. The lighter cream remains in the center, and leaves the separator by a different spout.

ROBERT F. PATON

Related Articles. For the specific gravity of all the elements, see ELEMENT, CHEMICAL (table). See also: Archimedes Hydrometer Pendulum Density Hydrostatics

GRAVITY CELL. See BATTERY (Closed-Circuit Cells).

GRAVURE. See PRINTING (Other Kinds of Printing).

GRAY is a color composed of a mixture of black and white pigments. Values of gray vary from nearly white to nearly black. Light grays look that way because they reflect more light than dark grays.

All colors become a neutral gray when reduced in intensity or strength. Whites and blacks placed close together in large numbers result in gray. Many tiny dots of black and white look gray to the eye.

Gray cloth often consists of black and white threads. A warm-looking gray usually also contains red threads, while a cool gray may contain blue threads. A color mixed with a small amount of the color opposite to it on the color wheel becomes grayed.

GEORGE L. BUSH

See also COLOR.

GRAY, ASA (1810-1888), became the leading authority of his time on the plant life of the United States. He specialized in classification and description of plants and gained fame for interpreting the plant life of past geological ages. His *Manual of Botany*, first published in 1848, helped to increase knowledge of plants growing in the northeastern United States, and to popularize botany.

He believed that each plant species originated in one place, and that physical means, such as wind, spread a plant species from its point of origin. In his own studies, he found evi-

Asa Gray

Chicago Historical Society

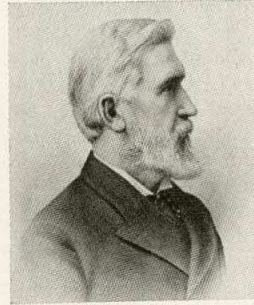


dence supporting Charles Darwin's principles of evolution, and he vigorously defended Darwin's ideas (see DARWIN, CHARLES ROBERT).

Gray was born at Sauquoit, N.Y. He became interested in botany while studying medicine, and spent his spare time roaming the countryside in search of plants. He received his medical degree from Fairfield Medical College in Herkimer County, New York, in 1831 but never practiced. He taught science in Utica, N.Y., and in 1836, he became curator at the New York Lyceum of Natural History. Two years later he was appointed professor of natural history at the University of Michigan. He then went to Europe to buy books for the university and to study European plants. In 1842, he became professor of natural history at Harvard University, and stayed there until his death. His library and herbarium formed the nucleus of the present Harvard University Herbarium, one of the largest and most noted in the world.

ROGERS McVAUGH

GRAY, ELISHA (1835-1901), an American inventor, disputed Alexander Graham Bell's claims as inventor of the telephone. He filed a claim with the United



Chicago Historical Society

Elisha Gray

States Patent Office stating his intention of inventing such a device only two hours after Bell filed his claim for a workable telephone. Western Union supported Gray's claims for "the most valuable single patent ever issued" in a bitter suit, but the claims were disallowed (see BELL, ALEXANDER GRAHAM). But Gray made a fortune from other devices, such as a harmonic telegraph for simultaneous transmission of

messages (see TELAUTOGRAPH). Born in Barnesville, Ohio, he studied at Oberlin College. Elisha Gray helped organize the Western Electric Company in Chicago, Ill.

RICHARD D. HUMPHREY

GRAY, ELIZABETH JANET (1902-), is an American author of books for children. She won the Newbery medal in 1943 for *Adam of the Road*. In 1946, she went to Japan as tutor to Crown Prince Akihito. In her adult book, *Windows for the Crown Prince*, she tells of her four years at the Japanese court. Her other books include *Young Walter Scott* (1935), *The Fair Adventure* (1940), and *Sandy* (1945). She was born in Philadelphia, and was graduated from Bryn Mawr.

EVELYN RAY SICKELS

GRAY, ROBERT (1755-1806), discovered the Columbia River and was the first to sail around the world under the American flag. He sailed from Boston in 1787 bound for the north Pacific by way of Cape Horn, and returned by way of China and the Cape of Good Hope in 1790. He set out again on the same route, and sailed into the mouth of the Columbia River in 1792. He named the river after his ship. His discovery became a basis for American claims to the Oregon Territory. He was born at Tiverton, R.I.

WILLIAM P. BRANDON

GRAY, STEPHEN. See ELECTRICITY (Learning About Electricity).



Brown Bros.; Gendreau

Thomas Gray, above, wrote his famous poem "Elegy Written in a Country Churchyard" after visiting the village church at Stoke Poges, left. Gray's tomb lies between the two windows outside the peaceful church.

GRAY, THOMAS (1716-1771), an English poet, wrote "Elegy Written in a Country Churchyard," one of the best-known poems in the English language. Some of its lines, such as "the paths of glory lead but to the grave," are still quoted. Perhaps even better known is the expression, "Where ignorance is bliss, 'tis folly to be wise," which appears in Gray's ode "On a Distant Prospect of Eton College." His other works include "An Ode to Spring," "Hymn to Adversity," "The Progress of Poesy," "The Bard," and "The Fatal Sisters." Gray is often considered a forerunner of the Romantic movement because of his interest in nature.

Born in London, he had an unhappy early life because of a jealous father. But his mother sympathized with him and contributed money to send him to school. Gray first went to Eton College. He continued his education at Cambridge University, where he spent much of his life. He traveled on the European continent with Horace Walpole, the son of England's Prime Minister, Robert Walpole (see WALPOLE). Gray also visited Stoke Poges. The village church there inspired him to write his famous "Elegy Written in a Country Churchyard."

By 1757, Gray had become so well known for his poems that the British government offered him the poet-laureateship. Gray refused to accept it. But he did agree to serve as professor of modern history at Cambridge University in 1768.

Gray was gentle and retiring and lived a quiet life, but he had many friends and carried on an extensive correspondence. Although he was indifferent to fame, he wrote that he loved people who "leave some of their trace behind them."

GEORGE F. SENSABAUGH

See also ELEGY; ROMANTICISM.

GRAY, WILLIAM SCOTT (1885-1960), an American educator, pioneered in reading studies starting in 1909. In his teaching and writing, he stressed the great role that reading skill and lifelong reading interests can play in promoting individual welfare and social progress. Gray was born in Coatsburg, Ill. He taught in the education department of the University of Chicago from 1914 to 1950. He retired and became the university's director of research in reading. ELIZABETH A. SIMPSON

GRAY CALL. See DUCK (Domestic Ducks; picture).

GRAY MATTER. See BRAIN (Gray and White Mat-

ter); NERVOUS SYSTEM (The Central Nervous System).

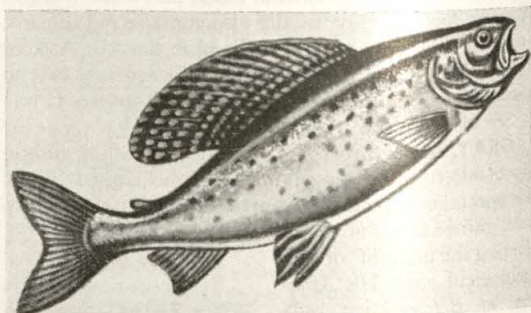
GRAYLING is a game fish, once called "the flower of fishes" by Saint Ambrose. The few known species live in the rivers and lakes of cool or Arctic regions. The European grayling may weigh as much as 4 or 5 pounds, and the American type weighs about 2 pounds.

Graylings resemble trout in their habits, but are more slender, graceful, and active. The grayling's scales also grow larger. Its beauty lies largely in its fins. American graylings live in the waters of the Arctic region, Montana, and Washington. They were once famous game fish in Michigan, but have died out there. The flesh of graylings is considered to be a great delicacy.

Scientific Classification. Graylings make up the family *Thymallidae*. The Montana grayling is genus *Thymallus*, species *signifer*.

CARL L. HUBBS

The Grayling is a Prized Game Fish of the Far North. This attractive fish has a very large and brightly colored back fin. The pelvic, or belly, fin is striped with rose and green.



GRAYSON, DAVID. See BAKER, RAY STANNARD.

GRAZ, *grahs* (pop. 226,454), is the second largest city in Austria, and the capital of the province of Styria. It lies on the Mur River. For location, see AUSTRIA (color map). Products include chemicals, hats, iron and steel products, leather, lithographic work, mathematical instruments, and paper. Charles Francis University dates from 1586. Buildings in Graz include a cathedral built in the 1400's; the Joanneum, a museum; and the Schlossberg, or castle. Bavarian Germans settled Graz during the Middle Ages.

R. JOHN RATH

GRAZIANI, *grah TSYAH nee*, **RODOLFO** (1882-1955), MARCHESE DI NEGHELLI, commanded the Army of the Po and later all the Italian troops in Africa during World War II. Captured by Italian partisans in 1945, Graziani was tried for treason for collaborating with the Germans. He was convicted in May, 1950, but was later freed. Graziani was born near Rome. He took an important part in capturing Ethiopia in 1935 and 1936, and served for a year as viceroy of Ethiopia (see ITALO-ETHIOPIAN WAR).

R. JOHN RATH

GRAZING. See AGRICULTURE (Raising Animals); PASTURE; RANCHING.

GREASEWOOD, also called black, or true, greasewood, is a scraggly thorny bush 2 to 6 feet high with stiff, gray-barked branches and narrow fleshy leaves. Greasewood grows over vast areas in the desert valleys, or flats, of Nevada, Utah, and other states of the Great Basin. The plants are indicators of underground waters. Greasewood is a valuable food plant for cattle and sheep.

Scientific Classification. Greasewood belongs to the goosefoot family, *Chenopodiaceae*. It is genus *Sarcobatus*, species *vermiculatus*.

EDMUND C. JAEGER

GREAT AUSTRALIAN BIGHT, *bite*, is the name given to part of the Indian Ocean near Australia. The bight lies within the curve made by the south coast of Australia and the island of Tasmania on the east. The Murray River empties into it.

GREAT AWAKENING was an unusually strong religious revival that swept the American colonies between 1740 and 1745. The Great Awakening movement in New England began mainly as a result of the preaching of Jonathan Edwards in Northampton, Mass. His sermons on sin and salvation stirred the townspeople and won many converts. His sermon called "Sinners in the Hands of an Angry God" proved particularly influential.

George Whitefield helped spread the revival throughout the colonies. His fiery evangelical speeches caused great excitement. His followers, Gilbert Tennent and James Davenport, went to such extremes that they aroused the opposition of the clergy.

Yale and Harvard universities and the Congregational Massachusetts General Convention of 1743 took a stand against the revival. Many persons turned to Unitarianism in revolt against emotional evangelism. The wave of excitement passed, but the revival left several lasting results. It developed a new interest in humanitarianism and the rights of the common man in the American colonies. It also led to the establishment of a number of new colleges, including the College of New Jersey (now Princeton University) with Jonathan Edwards as its president.

ALBERT E. AVEY

See also EDWARDS, JONATHAN; TENNENT; WHITEFIELD, GEORGE.

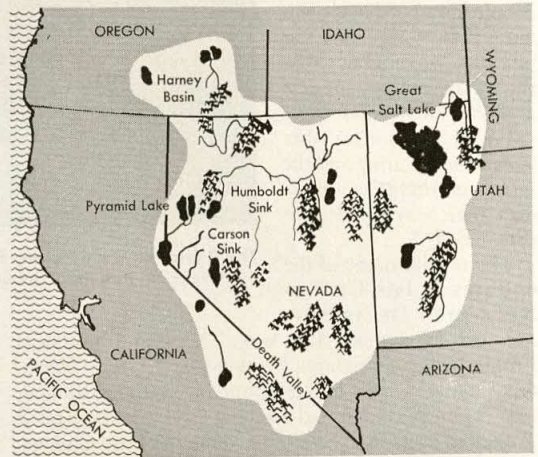
GREAT BARRIER REEF is the largest coral formation in the world. It extends in broken chains of reefs for about 1,250 miles along the northeast coast of Australia. Part of the reef lies only 10 miles from the shore, while other parts are as far as 150 miles from the coast. Reef rocks may be dangerous to ships, but sailors also find them helpful, because after ships pass inside, the reef shields them from the open sea. The water near the reef contains pearls and pearl shells.

F. G. WALTON SMITH

See also AUSTRALIA (Coast Line; color map; color picture, Vacationers; picture, Flowerlike Coral); CORAL.

GREAT BASIN, a large desert region in the western United States, is called a basin because nearly all the waters of its streams and lakes remain within it. Only the streams of the extreme northern and southern parts empty into the Pacific Ocean. The rest of the streams either dry up, or empty into one of the basin's lakes. Most of the lakes are salty, or *brackish*.

The basin covers about 200,000 square miles in California, Idaho, Nevada, Oregon, Utah, and Wyoming. Desert shrubs cover the basin, but few trees grow there. High mountains encircle the area, and other mountain ranges rise within it. Large pockets without outlets,



The Great Basin, shown in white, reaches into six states. Some rivers and lakes evaporate because they have no outlets.

called *sinks*, lie in some of the valleys. The largest sinks are the Great Salt Lake, Carson and Humboldt sinks, and Pyramid Lake. The deepest depressions of the Great Basin lie near its borders.

E. R. LARSON

GREAT BEAR. See BIG AND LITTLE DIPPERS.

GREAT BEAR LAKE is one of the largest lakes in the Americas. It covers 12,000 square miles in the Northwest Territories of Canada. Great Bear Lake lies about 250 miles east of the Rocky Mountains. Part of the lake is within the Arctic Circle. The Great Bear River drains the lake into the Mackenzie River. It becomes part of the longest navigable river system in Canada. For location, see NORTHWEST TERRITORIES (map).

The shores of Great Bear Lake are wooded, especially in the south. The area has a large trade in the furs of animals trapped in the forest. The cold, clear waters of the lake contain an abundance of fish, especially the herring salmon. Great Bear Lake received its name because of its large size and also because of the bears which lived along its shores.

Large quantities of pitchblende are mined near Port Radium on the southeast side of the lake. This ore, which contains radium and uranium, is shipped out by water in the short summer and by air in the winter. Silver ore is also mined near the lake. Dependence on uranium for atomic energy has made this source of supply important.

ALFRED LE ROY BURT

GREAT BIBLE. See COVERDALE, MILES.

GREAT BRITAIN

GREAT BRITAIN is the heart of the British Commonwealth of Nations. This island country off the coast of continental Europe is only about one fortieth as large as the United States. Yet Great Britain has ranked among the leading nations of the world for more than 500 years. The British people have been leaders in many fields—in science, exploration, government, and the arts. British courage and love of freedom have bound the people together in resisting tyranny and the terror of dictators whenever their way of life was threatened.

The official name of the country is **THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND**. The island of Great Britain includes England, Scotland, and Wales. Northern Ireland, which covers about one fifth of Ireland, also is part of the United Kingdom. The terms United Kingdom and Great Britain are often used interchangeably. The United Kingdom (including Northern Ireland) covers an area a little smaller than Oregon. But Great Britain has about 29 times as many people as live in Oregon. London is the capital and largest city.

The face of the land varies from one part of the country to another. Great manufacturing cities and thriving farms lie on the green, rolling plains of England. Deposits of coal and other valuable minerals are mined in the steep hills and mountains of Wales. Scotland's bleak Highlands are almost too rugged for anything but grazing sheep. But the Scottish Lowlands support large manufacturing and shipbuilding industries. The low grasslands and mild climate of Northern Ireland provide excellent grazing for livestock.

Great Britain rose to world power after Scotland was united with England and Wales in 1707. This union



Gendreau

The British have a deep love for their land and for the sea. Great Britain became a world power by developing its natural resources. At the same time, it used the seas as highways of commerce.

took place only 68 years before the beginning of the Revolutionary War in America. Within 50 years after the Revolution, the British had founded an empire extending around the world. Britain developed its colonies and started them on the road to self-govern-

FACTS IN BRIEF

Type of Government: Constitutional monarchy.

Capital: London.

Divisions: *England*, divided into 50 administrative (or 39 historical) counties; *Northern Ireland*, 6 counties; *Scotland*, 33 counties; *Wales*, 13 counties.

Head of State: Monarch (Queen or King).

Head of Government: Prime Minister, appointed by the Crown from the majority party in the House of Commons.

Parliament: *House of Lords*, about 850 life members; *House of Commons*, 630 members elected by the people (five-year terms).

Area: 94,212 square miles. *Greatest distance:* (north-south) 600 miles; (east-west) 320 miles. *Coast line*, 4,000 miles.

Elevation: *Highest*, Ben Nevis, Scotland, 4,406 feet; *Lowest*, the Fens, near Ely, below sea level.

Population: 50,784,600. *Density*, about 538 persons to the square mile. *Distribution*, urban, 80 per cent; rural, 20 per cent.

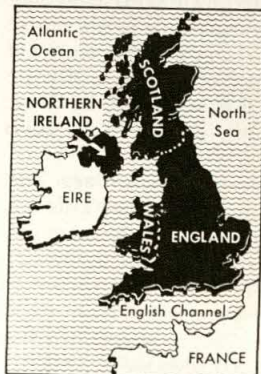
Chief Products: *Agriculture*, barley, cheese, flax, fruits, hops, oats, potatoes, sugar beets, wheat. *Manufacturing and Processing*, automobiles, chemicals, clothing, earthenware, electrical goods, glassware, machinery, metal goods, paper, processed foods, ships, textiles, wood products. *Mining*, bauxite, building stone, coal, gravel, iron, lead, salt, tin, zinc. *Fishing Industry*, cod, haddock, halibut, herring, mackerel, plaice, salmon, sole.

Flag: The Union Flag combines red-on-white crosses of St. George and St. Patrick with the white-on-blue cross of St. Andrew. See **FLAG** (color pictures).

National Anthem: "God Save the Queen" (or King).

National Holiday: Celebration of the monarch's official birthday, usually in late spring.

Money: *Basic unit*, Pound. For its value in dollars, see **MONEY** (table, Values). See also **POUND**.



Great Britain (black) is smaller than the state of Oregon.



Divisions

ENGLAND AND WALES	E 5
Pop.	44,274,000
England, 41,673,000	D 6
Wales (incl. Monmouthshire), 2,601,000	D 5
NORTHERN IRELAND	C 3
Pop.	1,387,300
SCOTLAND	B 4
Pop.	5,123,300

Cities

Aberdare (Wales), 40,200	E 5
Aberdeen (Scotland), 186,400	B 5
Aberfeldy (Scotland), 1,500	B 5
Abergavenny (England), 8,900	E 5
Aberystwyth (Wales), 10,400	D 4
Acton (England), 66,200	111
Aldershot (England), 38,700	E 6
Alloa (Scotland), 13,900	B 5
Alnwick (England), 7,300	C 6
Annan (Scotland), 5,000	C 5
Arbroath (Scotland), 19,900	B 5
Ardrrossan (Scotland), 9,400	C 4
Armagh (N. Ire.), 9,279	C 3
Ashton-under-Lyne (England), 51,350	D 5
Aylesbury (England), 21,800	E 6
Ayr (Scotland), 43,400	C 4
Ballahtree (Scotland), 886	C 4
Balleray (Scotland), 1,200	B 5
Ballycastle (N. Ire.), 2,558	C 3
Ballymena (N. Ire.), 14,165	C 3
Banbridge (N. Ire.), 6,098	C 3
Banbury (England), 19,300	D 6
Banff (Scotland), 3,300	B 5
Bangor (N. Ire.), 20,615	C 4
Bangor (Wales), 13,700	D 4
Barking (England), 75,600	113
Barnmouth (Wales), 2,330	D 4
Barnsley (England), 74,800	D 6
Barnstaple (England), 15,800	E 4
Barrow-in-Furness (England), 64,900	C 5
Barvas (Scotland), 19,900	E 6
Basingstoke (England), 19,900	E 6
Bath (England), 79,800	E 5
Beckenham (England), 75,300	112
Beddington and Wallington (England), see Wallington	
Bedford (England), 56,500	D 6
Bedlington (shire) (England), 29,100	C 6
Belfast (N. Ire.), 450,800	C 4
Berwick-on-Tweed (England), 12,700	C 6
Bethyld (Scotland), 14,600	E 7
Beverley (England), 15,600	D 6
Bexhill-on-Sea (England), 26,200	E 7
Bexley (England), 89,300	E 7
Bideford (England), 10,200	E 4
Birkenhead (England), 141,600	D 5
Birmingham (England), 1,110,800	D 6
Bishop's Stortford (England), 14,600	E 7
Blackburn (England), 107,900	D 5
Blackpool (England), 146,500	D 5
Blackpool (England), 241,000	D 5
Blairgowrie (and Rattray) (Scotland), 5,300	B 5

Blyth (England), 34,500	C 6
Bodmin (England), 6,000	E 4
Bolton (England), 163,800	D 5
Boston (England), 24,200	D 6
Bournemouth (England), 142,600	E 6
Bradford (England), 286,400	D 6
Brechin (Scotland), 7,400	B 5
Brecon (Breconnock) (Wales), 6,200	E 5
Brentford (and Chiswick) (England), 58,300	111
Bridgwater (England), 24,100	E 5
Bridlington (England), 24,600	C 6
Brighton (England), 158,700	E 6
Bristol (England), 440,500	E 5
Bromley (England), 65,100	113
Brockhaven (and Methil) (Scotland), 21,300	B 5
Buckhurst Hill (England) (part of Chigwell), 113	
Buckie (Scotland), 7,800	B 5
Bude (I-Stratton) (England), 5,200	E 4
Burnley (England), 82,400	D 5
Burton-on-Trent (England), 48,900	D 6
Bury (England), 58,200	D 5
Bury St. Edmunds (England), 20,900	D 7
Caernarvon (Wales), 9,200	D 4
Callander (Scotland), 1,600	B 4
Camborne (Redruth) (England), 35,300	E 4
Cambridge (England), 91,800	D 7
Campbeltown (Scotland), 7,000	C 4
Canterbury (England), 30,000	E 7
Cardiff (Wales), 249,800	E 5
Cardigan (Wales), 3,500	D 4
Carlisle (England), 68,500	C 5
Carmarthen (Wales), 11,800	E 4
Carrickfergus (N. Ire.), 8,650	C 4
Carshalton (England), 61,000	112
Castle Douglas (Scotland), 3,300	C 5
Chatham (England), 49,900	E 7
Chelmsford (England), 41,420	E 7
Cheltenham (England), 68,000	E 5
Chepstow (England), 5,900	E 5
Chester (England), 58,800	D 5
Chesterfield (England), 67,200	D 6
Chichester (England), 19,000	E 6
Chigwell (England), 59,700	113
Chingford (England), 46,800	113
Chislehurst (and Sidcup) (England), 87,300	113
Chiswick (England) (part of Brentford and Chiswick), 111	
Cirencester (England), 11,800	E 6
Clydebank (Scotland), 48,800	C 4
Coatbridge (Scotland), 51,100	C 5
Colchester (England), 61,900	E 7
Coleraine (N. Ire.), 10,748	C 3
Coupar Angus (Scotland), 2,200	B 5
Coventry (England), 272,600	D 6
Cowes (England), 16,800	E 6
Crew (England), 51,500	D 5
Creef (Scotland), 5,400	B 5

Cromarty (Scotland), 700	B 4
Croydon (England), 249,300	E 6, 112
Cruden (Scotland), 2,294	B 6
Dagenham (England), 115,300	E 7
Dalmellington (Scotland), 4,702	C 4
Darlington (England), 83,400	C 6
Dartmouth (England), 6,000	E 5
Denbigh (Wales), 7,900	D 5
Derby (England), 137,500	D 6
Dewsbury (England), 53,300	D 6
Dingwall (Scotland), 3,500	B 4
Donaghadee (N. Ire.), 3,398	C 4
Doncaster (England), 83,200	D 6
Dorchester (England), 11,400	E 5
Dornoch (Scotland), 900	B 4
Dover (England), 35,400	E 7
Downpatrick (N. Ire.), 3,878	C 4
Dudley (England), 64,400	D 5
Dumfries (Scotland), 26,700	C 5
Dunbar (Scotland), 4,200	C 5
Dundee (Scotland), 178,500	B 5
Dunfermline (Scotland), 45,700	B 5
Dungannon (N. Ire.), 5,674	C 3
Dunoon (Scotland), 9,100	C 4
Durham (England), 20,500	C 6
Durness (Scotland), 413	A 4
Ealing (England), 184,200	E 6, 111
East Barnet (New Barnet) (England), 40,660	112
East Ham (England), 114,400	113
Eastbourne (England), 57,900	E 7
Edgware (England) (part of Hendon), 111	
Edinburgh (Scotland), 466,900	C 5
Edmonton (England), 98,100	112
Elgin (Scotland), 11,300	B 5
Elton (Scotland), 1,500	B 5
Ely (England), 9,900	D 7
Enfield (England), 109,000	E 6
Enniskillen (N. Ire.), 6,318	C 3
Exeter (England), 77,000	E 5
Exmouth (England), 17,800	E 5
Eymouth (Scotland), 2,100	C 5
Falkirk (Scotland), 37,100	C 5
Falmouth (England), 16,500	E 4
Farnham (Scotland), 1,317	B 5
Festiniog (Wales), 6,500	D 5
Finchley (England), 69,800	112
Fishguard (and Goodwick) (Wales), 4,800	E 4
Folkestone (England), 44,900	E 7
Forfar (Scotland), 10,000	B 5
Forres (Scotland), 5,000	B 5
Fort William (Scotland), 2,900	B 4
Fraserburgh (Scotland), 10,500	B 6
Friern Barnet (England), 28,600	112
Gainsborough (England), 17,400	D 6
Gairloch (Scotland), 1,991	B 4
Galashiels (Scotland), 12,200	C 5
Gateshead (England), 111,900	C 6
Gillingham (England), 77,600	E 7
Girvan (Scotland), 5,900	C 4
Glasgow (Scotland), 1,081,700	C 4
(1,600,000)	C 4

(Map Index) GREAT BRITAIN

Glastonbury (England), 5,300	D 7
Gloucester (England), 67,300	E 5
Gosport (England), 63,200	E 6
Grantham (England), 23,700	D 6
Gravesend (England), 47,700	E 7
Great Yarmouth (England), 51,500	D 7
Greenock (Scotland), 77,700	C 4
(110,000)	C 4
Greenwich (England), 88,800	112
(part of London)	112
Grimby (England), 95,400	D 6
Guildford (England), 50,600	E 6
Halifax (England), 96,400	D 6
Hamilton (Scotland), 41,200	C 4
Harlow (England), 29,800	E 7
Harris (Scotland), 51,900	B 3
Harrogate (England), 51,900	D 6
Harrow (England), 216,200	E 6
Hartlepool (England), 17,100	C 6
Harwich (England), 15,100	E 7
Hastings (England), 64,600	E 7
Hawick (Scotland), 16,800	C 5
Helensburg (Scotland), 8,600	B 4
Helmsdale (Scotland), 153,200	112
Hereford (England), 33,200	D 5
Hertford (England), 14,800	E 6
Heston and Isleworth (England), 105,600	E 6
High Wycombe (England), 43,400	E 6
Holyhead (Wales), 10,300	D 4
Hornchurch (England), 107,100	E 7
Hornsea (England), 5,400	D 6
Hornsey (England), 97,200	112
Hove (England), 69,700	E 6
Huddersfield (England), 127,600	D 6
Hull (Kingston upon Hull) (England), 300,200	D 6
Huntly (Scotland), 4,000	B 5
Ilford (England), 180,600	113
Ilfracombe (England), 8,800	E 4
Inveraray (Scotland), 500	B 4
Inverness (Scotland), 28,300	B 4
Ipswich (England), 110,300	D 7
Irvine (Scotland), 15,700	C 4
Jedburgh (Scotland), 4,100	C 5
Keighley (England), 55,500	D 6
Keith (Scotland), 4,400	B 5
Kelso (Scotland), 4,200	C 5
Kendal (England), 18,500	C 5
Kettering (England), 37,000	D 6
Kew (England) (part of Richmond), 39,000	111
Kidderminster (England), 39,000	D 5
Killin (Scotland), 1,199	B 4
Kilmallie (Scotland), 43,900	C 4
Kilmarnock (Scotland), 43,900	C 4
Kilmonivag (Scotland), 11,000	C 4
King's Lynn (England), 26,200	D 7
Kingston-on-Thames (England), 38,800	111
Kingussie (Scotland), 1,100	B 4
Kirkcaldy (Scotland), 51,500	B 5
Kirkcudbright (Scotland), 2,500	C 4
Kirkwall (Scotland), 4,300	A 5
Lairg (Scotland), 962	A 4
Lanark (Scotland), 8,100	C 5
Lancaster (England), 49,500	C 5
Larne (N. Ire.), 11,976	C 4
Latheron (Scotland), 2,593	A 5
Launceston (Dunheved) (England), 4,700	E 4
Leamington (England), 38,200	D 6
Leeds (England), 508,600	D 6
(1,100,000)	D 6
Leicester (England), 284,800	D 6
Leiston (Cum Sizewell) (England), 4,100	D 7
Lerwick (Scotland), 5,600	G10
Leven (Scotland), 8,900	B 5
Lewes (England), 13,300	B 5
Leyton (England), 100,900	112
Lincoln (England), 70,500	D 6
Lisburn (N. Ire.), 14,778	C 3
Liverpool (England), 773,700	D 5
(1,470,000)	D 5
Llandrindod Wells (Wales), 3,200	D 5
Llandudno (Wales), 16,700	D 5
Llanelli (Wales), 31,900	E 4
Lochbroom (Scotland), 153,200	B 4
London (England), 3,273,000	112
(Greater London, 2,270,400)	112
(10,450,000)	112
Londonderry (N. Ire.), 50,300	C 3
Loughborough (England), 36,000	D 6
Loughton (England) (part of Chigwell), 113	
Louth (England), 11,400	D 7
Lowestoft (England), 43,700	D 7
Ludlow (England), 6,500	D 5
Lurgan (N. Ire.), 16,181	C 3
Luton (England), 114,500	E 6
Macclesfield (England), 36,300	D 5
Maidstone (England), 55,500	E 7
Mallaig (Scotland), 149,900	B 4
Malton (England), 4,200	C 6
Manchester (England), 686,000	D 5
(1,975,000)	D 5
Mansfield (England), 51,900	D 6
Margate (England), 43,100	E 7
Maryport (England), 12,500	C 5
Maud (Scotland), 4,900	B 5
Maybole (Scotland), 4,900	C 4
Merthyr Tydfil (Wales), 59,500	E 5
Middlesbrough (England), 149,900	C 6
(315,000)	C 6
Milford Haven (Wales), 12,000	E 4
Minehead (England), 7,400	E 5
Mitcham (England), 65,000	112
Montrose (Scotland), 10,800	B 5
Motherwell (and Wishaw) (Scotland), 70,700	C 5
Musselburgh (Scotland), 18,100	B 5
Nairn (Scotland), 4,700	B 5
Neath (Wales), 31,300	E 5
New Cumnock (Scotland), 3,871	C 4
New Galloway (Scotland), 300	C 4

Source: Latest available official figures. * Population of metropolitan area, including suburbs.
* Place names marked by an asterisk do not appear on the map. Key shows general location.



GREAT BRITAIN

Legend:

- National Capital
- Cities
- Railroads
- Canals
- Regional Boundaries
- Evergreen Trees
- Deciduous Trees
- Shrub

Scale: 1 inch = 57 statute miles

Conic Projection

Miles 0 10 20 30 40 50 60

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GREAT BRITAIN (Map Index)

New Malden (Malden and Coombe) (Eng.), 45,800	J11
Newark [on Trent] (Eng.), 23,600	D 6
Newbury (Eng.), 19,300	E 6
Newcastle-on-Tyne (Eng.), 277,100 (*841,700)	C 6
Newcastle-under-Lyme (Eng.), *73,200	D 5
Newport (Eng.), 20,200	E 6
Newport (Wales), 104,900	E 5
Newquay (Eng.), 10,100	E 4
Newry (N. Ire.), 13,264	C 3
Newtown [and Llan-llychwaia] (Wales), 5,400	D 5
Newtownards (N. Ire.), 12,237	C 4
North Walsham (Eng.), 4,800	D 7
Northampton (Eng.), 101,800	D 6
Norwich (Eng.), 120,300	D 7
Nottingham (Eng.), 312,500 (*480,000)	D 6
Oban (Scot.), 6,100	B 4
Okehampton (Eng.), 3,900	E 4
Oldham (Eng.), 119,500	D 5
Omagh (N. Ire.), 6,762	C 3
Orpington (Eng.), 70,400	J13
Oswestry (Eng.), 11,000	D 5
Oxford (Eng.), 104,500	E 6
Paisley (Scot.), 95,500	C 4
Peebles (Scot.), 5,700	C 5
Pembroke (Wales), 13,800	E 4
Penzance (Eng.), 19,800	E 4
Perth (Scot.), 41,100	B 5
Peterborough (Eng.), 54,400	D 6
Peterhead (Scot.), 12,700	B 6
Pitlochry (Scot.), 2,300	B 5
Plymouth (Eng.), 216,200	E 4
Poole (Eng.), 86,000	E 5
Port Talbot (Wales), *47,100	E 5
Portlaoine (N. Ire.), 17,202	C 3
Portpatrick (Scot.), 1,063	C 4
Portsmouth (Eng.), 231,000 (*385,000)	E 6
Preston (Eng.), 117,200	D 5
Pwllheli (Wales), 3,700	D 4
Ramsgate (Eng.), 36,000	E 7
Reading (Eng.), 117,900	E 6
Reigate (Eng.), 48,700	E 6
Rhondda (Wales), 107,400	E 5
Rhyl (Wales), 19,500	D 5
Richmond (Eng.), 42,400	J11
Ripon (Eng.), 10,100	C 6
Rochdale (Eng.), 86,300	D 5
Rochester (Eng.), *46,200 (*175,000)	E 7
Romford (Eng.), *105,900	E 7
Rotherham (Eng.), *82,900	D 6
Rothsay (Scot.), 9,400	C 4
Rugby (Eng.), *47,100	D 6
Ryde (Eng.), 20,000	E 6
St. Albans (Eng.), 46,700	E 6
St. Andrews (Scot.), 9,600	B 5
St. Helens (Eng.), *110,900	D 5
Salford (Eng.), 167,400	D 5
Salisbury (Eng.), 34,000	E 6
Scarborough (Eng.), 43,900	C 6
Scurie (Scot.), 58,800	A 4
Scunthorpe (Eng.), 58,800	D 6
Selkirk (Scot.), 5,800	C 5
Sheerness (Eng.), 15,500	E 7
Sheffield (Eng.), 499,000 (*660,000)	D 6
Sheringham (Eng.), 4,600	D 7
Shrewsbury (Eng.), 46,900	D 5
Sidcup (Eng.) (part of Chislehurst and Sidcup)	J13
Sidmouth (Eng.), 9,800	E 5
Skene (Eng.), 12,600	D 7
Slough (Eng.), 69,200	E 6
Smethwick (Eng.), 74,400	D 5
South Shields (Eng.), 108,100	C 6
Southampton (Eng.), 196,400	E 6
Southend-on-Sea (Eng.), 155,800	E 7
Southernport (Eng.), 82,100	D 5
Spalding (Eng.), 14,600	D 6
Spilsby (Eng.), 1,486	D 7
Stafford (Eng.), 41,400	D 5
Stirling (Scot.), 26,800	B 5
Stockport (Eng.), 140,900	D 5
Stockton-on-Tees (Eng.), 75,700	C 5
Stoke-on-Trent (Eng.), 273,000 (*425,000)	D 5
Stonehaven (Scot.), 4,500	B 5
Stornoway (Scot.), 5,200	A 3
Strabane (N. Ire.), 6,520	C 3
Stranraer (Scot.), 8,700	C 4
Stratford (Eng.) (part of West Ham)	I12
Stratford-on-Avon (Eng.), 14,900	D 6
Sunderland (Eng.), 182,800	C 6
Surbiton (Eng.), 62,600	J11
Sutton [and Cheam] (Eng.), 78,800	J12
Sutton-in-Ashfield (Eng.), 40,300	D 6
Swansea (Wales), 161,700	E 5
Swindon (Eng.), 74,000	E 6
Tain (Scot.), 1,600	B 4
Taunton (Eng.), 34,100	E 5
Thetford (Eng.), 4,700	D 7
Thornaby-on-Tees (Eng.), 23,900	C 6
Thurrock (Eng.), *97,800	E 7
Thurso (Scot.), 3,600	A 5
Tiverton (Eng.), 11,700	E 5
Torquay (Eng.), 50,000	E 5
Tottenham (Eng.), 120,700	I12
Tregaron (Wales), 1,243	D 5
Trowbridge (Eng.), 14,400	E 5
Truro (Eng.), 13,500	E 4
Tunbridge Wells (Eng.), 38,900	E 7
Twickenham (Eng.), 104,000	J11
Tynemouth (Eng.), 67,700	C 6
Uig (Scot.), 1,000	B 3
Ullapool (Scot.), 1,000	B 4
Ulverston (Eng.), 10,400	C 5
Wakefield (Eng.), *59,750	D 6

Wallasey (Eng.), 102,300	D 5
Wallington (Beddington and Wallington) (Eng.), *32,500	J12
Walsend (Eng.), 49,600	C 6
Walsall (Eng.), 114,700	D 6
Walthamstow (Eng.), 116,700	I12
Wanstead and Woodford (Eng.), see Woodford	
Warrington (Eng.), 79,600 (*125,000)	D 5
Warwick (Eng.), 15,700	D 6
Watford (Eng.), *72,520	E 6
Wells (next the Sea), 2,600	D 7
Welshpool (Wales), 6,100	D 5
Wembley (Eng.), 128,300	I11
West Bromwich (Eng.), 90,700	D 6
West Ham (Eng.), 167,000	I13
West Hartlepool (Eng.), 73,200	C 6
West Wickham (Eng.) (part of Beckenham)	J12
Weston-super-Mare (Eng.), 40,300	E 5
Weymouth [and Melcombe Regis] (Eng.), 37,900	E 5
Whitby (Eng.), 11,500	C 6
Whitehaven (Eng.), 25,700	C 5
Whithorn (Scot.), 1,000	C 4
Wick (Scot.), 7,500	A 5
Widnes (Eng.), *50,100	D 5
Wigan (Eng.), *82,100	D 5
Wigtown (Scot.), 1,300	C 4
Willesden (Eng.), 174,900	I12
Wimbledon (Eng.), 57,800	J12
Winchester (Eng.), 27,600	E 6
Windermere (Eng.), 6,400	C 5
Windsor (New Windsor) (Eng.), *25,580	E 6
Wisbech (Eng.), 17,200	D 7
Witbessea (Eng.), 5,000	D 7
Wolverhampton (Eng.), 153,100	D 5
Wolverton (Eng.), 13,500	D 6
Wood Green (Eng.), 50,100	I12
Woodford (Wanstead and Woodford) (Eng.), 61,100	I13
Woolwich (Eng.) (part of London)	J13
Worcester (Eng.), 63,400	D 5
Workington (Eng.), 29,100	C 5
Worthing (Eng.), 71,600	E 6
Wrexham (Wales), 32,800	D 5
Yarmouth (Eng.), see Great Yarmouth	
Yeovil (Eng.), 24,000	E 5
York (Eng.), 106,200	D 6

ISLANDS IN THE BRITISH SEAS

GUERNSEY (incl. Dependencies)

Population 45,474

Cities

St. Peter Port, 17,500 F 5

ISLE OF MAN

Population 55,213

Cities

Douglas, 20,288	C 4
Ramsey, 4,607	C 4

JERSEY

Population 57,310

Cities

St. Helier, 25,360 F 5

Physical Features

Alderney (Isl.)	F 5	Lundy Isl.	E 4
Anglesey (Isl.)	D 4	Mainland (Isl.)	G10
Arran (Isl.)	C 4	Man, Isle of	C 4
Avon R.	D 6	Mersey R.	D 5
Avon R.	E 6	Minch, The (Channel)	B 3
Barra (Isl.)	B 3	Moray Firth	B 5
Barra Head	B 3	Morecambe Bay	D 5
Beinn Dearg (Mtn.)	B 4	Mountains of Antrim	C 3
Ben Attow (Mtn.)	B 4	Mourne Mts.	C 3
Ben Hope (Mtn.)	A 4	Muck (Isl.)	B 3
Ben Macdhui (Mtn.)	B 5	Mull (Isl.)	B 3
Ben More Assynt (Mtn.)	A 4	North Channel	C 3
Ben Nevis (Mtn.)	B 4	North Downs	E 7
Blackdown Hills	E 5	North Foreland	E 7
Bodmin Moor	E 4	North Ronaldsay (Isl.)	A 5
Brecon Beacons (Mts.)	E 5	North Sea	B 7
Bristol Channel	E 4	North Uist	B 3
Butt of Lewis (Head)	A 3	North York Moors	C 6
Caernarvon Bay	D 4	Northwest Highlands	B 4
Caledonian Canal	B 4	Orkney Is.	A 5
Calf of Man (Isl.)	C 4	Oronsay, Passage of	C 3
Cam R.	D 7	Ouse R.	D 6
Cambrian Mts.	D 5	Outer Hebrides (Is.)	B 3
Canna (Isl.)	B 3	Pennine Chain (Mts.)	C 5
Cape Wrath	A 4	Pentland Firth	A 5
Cardigan Bay	D 4	Pomona (Mainland) (Isl.)	A 5
Carmarthen Bay	E 4	Portland Bill (Promontory)	E 5
Channel Is.	F 5	Radnor Forest	D 5
Cheviot Hills	C 5	Rathlin Isl.	C 3
Coll (Isl.)	B 3	Roding R.	I13
Colonsay (Isl.)	B 3	Rousay (Isl.)	A 5
Cotswold Hills	E 5	Rum (Isl.)	B 3
Cullin Sound	B 3	St. Albans Head	E 6
Dartmoor (Moor)	E 5	St. Bees Head	C 5
Dee R.	B 5	St. Brides Bay	E 4
Dee R.	D 5	St. David's Head	E 4
Dornoch Firth	B 5	St. George's Channel	E 3
Dover, Strait of	E 7	St. Magnus Bay	G 9
Duncansby Head	C 4	Salisbury Plain	E 6
Dundrum Bay	C 4	Sanday (Isl.)	A 5
Eddystone Rocks (Reef)	E 4	Sark (Isl.)	F 5
Eden R.	C 5	Scapa Flow (Channel)	A 5
Eigg (Isl.)	B 3	Scilly Is.	F 3
English Channel	F 5	Severn R.	D 5
Exmoor (Moor)	E 5	Shetland Is.	G10
Farne Is.	C 6	Skye (Isl.)	D 4
Fens, The	D 7	Snowdon (Mtn.)	C 4
File Ness (Promontory)	B 5	Solway Firth	E 6
Firth of Forth	B 5	South Downs	E 6
Firth of Lorne	B 3	South Ronaldsay (Isl.)	A 5
Firth of Tay	B 5	South Uist (Isl.)	B 3
Flamburgh Head	C 6	Southern Uplands	C 3
Flannan Is.	A 3	Sperrin Mts.	B 5
Foula (Isl.)	G 9	Spye R.	E 5
Grampian (Mts.)	B 4	Start Pt.	E 7
Guernsey (Isl.)	F 5	Stour R.	E 5
Hartland Pt.	E 4	Strangford Lough (Bay)	C 4
Hebrides, Sea of the	B 3	Stronsay (Isl.)	A 5
Holy Isl.	C 6	Sumburgh Pt.	H10
Holy Isl.	D 4	Swale R.	C 6
Hoy (Isl.)	A 5	Tay R.	B 5
Humber R.	D 6	Tarbat Ness (Promontory)	B 5
Inner Sound	B 4	Tees R.	C 5
Irish Sea	D 4	Test R.	E 6
Islay (Isl.)	C 3	Thames R.	E 7
Jersey (Isl.)	F 5	Thames, Mouth of the	B 3
Jura (Isl.)	C 4	Tiree (Isl.)	D 4
Jura, Sound of	C 4	Tremadoc Bay	D 6
Kinnairds Head	B 6	Trent R.	C 5
Lake District (Region)	C 5	Tweed R.	C 5
Land's End (Pt.)	E 3	Tyne R.	G10
Lea (Navigation Canal)	I12	Unst (Isl.)	C 3
Lewis with Harris (Isl.)	A 3	Upper Lough Erne (Lake)	C 5
Lincoln Wolds (Hills)	D 6	Walney (Isl.)	D 7
Little Minch (Channel)	B 3	Wash, The	D 7
Lizard Pt.	F 4	Waveney R.	D 6
Llwyn Pen	D 4	Welland R.	D 7
Loch Broom (Inlet)	B 4	Wensum R.	E 5
Loch Carron (Inlet)	B 4	Western Downs	E 5
Loch Fyne (Inlet)	B 4	Westray (Isl.)	D 6
Loch Linnhe (Inlet)	B 4	Wharfe R.	E 4
Loch Lomond (Lake)	B 4	Wight, Isle of	C 4
Loch Shin (Lake)	A 4	Wigtown Bay	G10
Loch Tay (Lake)	B 4	Yell (Isl.)	C 6
Lough Erne (Lake)	C 3	York Wolds (Hills)	C 6
Lough Neagh (Lake)	C 3		
Luce Bay	C 4		

Source: Latest available official figures. * Population of metropolitan area, including suburbs.
 * Place names marked by an asterisk do not appear on the map. Key shows general location.

ment as members of the Commonwealth of Nations.

Great Britain became a world power only about 250 years ago, but the British people have many traditions that go back thousands of years. They are deeply devoted to their royal family and their form of government.

The Land and Its Resources

Location, Size, and Surface Features. Great Britain is the largest island of Europe and the seventh largest island in the world. The waters of the North Sea and the English Channel separate Great Britain from Europe. The *color map* shows that Ireland lies to the west of Great Britain, across the Irish Sea.

England occupies the southern and eastern parts of Great Britain. It has an area of 50,327 square miles. *Scotland*, covering 30,409 square miles, lies to the north. *Wales*, to the west, has an area of 8,016 square miles, and *Northern Ireland*, 5,460 square miles.

Along its southern shores, the island of Great Britain is about 320 miles wide from east to west. It narrows to a width of only 30 miles in Scotland, between the Firth of Forth and the Firth of Clyde. The island is about 600 miles long from Land's End, in the southwest, to John O'Groats, in the northeast. It has many deep bays and *estuaries*, or river mouths. No part of Great Britain is more than 70 miles from the sea.

Natural Regions. Great Britain has six distinct natural regions.

The *Highlands* in northern Scotland are a barren, bleak region of mountain ranges, plateaus, deep valleys, and lakes. Ben Nevis, the highest peak in Great Britain, rises in the Highlands.

The *Scottish Lowlands* lie in the valleys of the Clyde, Forth, and Tay rivers. Scotland's principal cities lie in this area.

The *Pennine Chain*, a region rich in iron and coal, extends south from the Scottish Lowlands. Many geographers consider the Cambrian Mountains of Wales and the Cornish Heights of Cornwall as extensions of the Pennine Chain.

The *Midlands* is a lowland region between the southern end of the Pennine Chain and the Cambrian Mountains of Wales. Many of the largest manufacturing and shipping industries lie in the Midlands.

The *Southeastern Plains* include the entire area south and east of the Pennines and the Midlands. This region includes chalk downs (rolling, treeless plains), low plains and fenlands (marshy areas), and the river basins around London and Southampton. These plains were the first part of the island to be settled, and are Great Britain's best farm land.

Northern Ireland is a lowland region surrounding an area of peat bogs. It includes Lough Neagh, the largest lake in the United Kingdom.

Rivers and Bays. Many bays form part of the 4,000-mile-long coast line. The sea extends far up the mouths of many rivers, forming estuaries. The Clyde, Forth, Humber, Mersey, Severn, and Thames rivers all have estuaries that make fine harbors. Cities on these estuaries serve as centers of ocean and inland commerce.

Great Britain is not large enough to have many long rivers. The two longest, the Thames and the Severn in England, are only a little more than 200 miles long.

Natural Resources. The most important natural resources are coal and iron ore. These minerals have

GREAT BRITAIN

helped to make the country a great manufacturing nation. The main deposits of coal and iron lie in the region of the Pennine Chain, but coal is also mined in other regions.

Layers of limestone and chalk lie under the rich soil of southeastern England. The chalk forms the famous white cliffs of Dover on the shore of the English Channel. Because of these cliffs, England was once called *Albion*, from the Latin word meaning *white*.

Deposits of lead, zinc, and tin lie in Wales and Cornwall, the rugged peninsula of southwestern England. Bauxite, used in making aluminum, is the only important mineral found in Northern Ireland.

The British Isles are surrounded by a shallow ocean bed called the *continental shelf*. This shelf stretches across the North Sea, and into the Atlantic Ocean. The shallow waters in these areas contain many fishes.

Much of the soil is good, but the country cannot produce enough food for its many people. The best farm lands lie in the Midlands and along the east coast in the area near The Wash. Scotland's Highlands and Northern Ireland's peat bogs are not suitable for farming.

Climate. Great Britain lies farther north than any point in the continental United States. But it has a much milder climate than any of the Northern States. It is free from extreme heat or cold. Sea winds pass over the mild Gulf Stream to warm Great Britain's shores and bring plenty of rain. Southwestern England has mild winters and almost no snow. Wales and central and eastern England are a little colder. Light snow often falls in the Pennine Chain of England and on Snowdon, the highest peak in Wales. Scotland has cold winters. Northern Ireland has damp weather throughout the year. The temperature averages 38°F. in winter, and rises to about 63°F. in summer.

Great Britain has much rain throughout the year. The heaviest rains fall in Northern Ireland, along the west coast of Scotland, in the Lake District of England, and around the peak of Snowdon, in Wales. London has only about 24 inches of rain a year, and Glasgow has about 37 inches. But other regions may have as much as 100 inches.

Fogs sometimes hang over Great Britain for days. Dark clouds roll in from the sea and mix with smoke from factories and homes to form *smog*. Smogs are thickest over the London area.

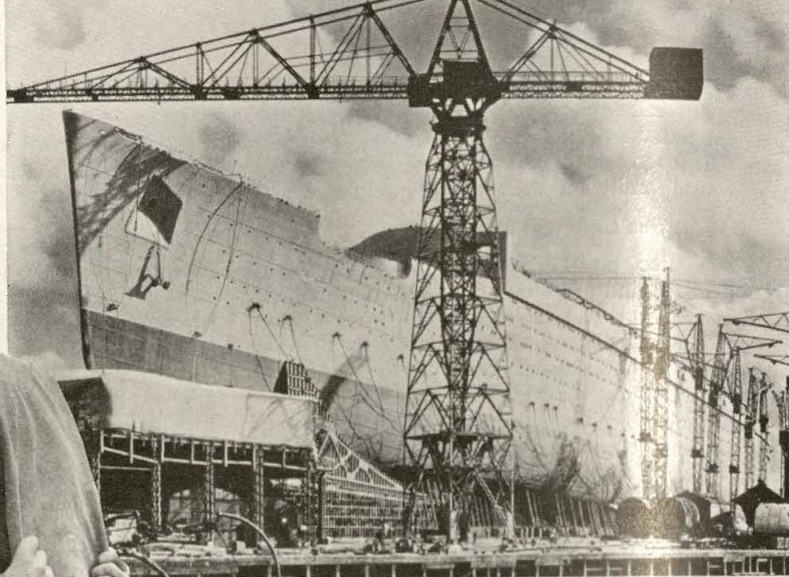
The People and Their Work

The People. Great Britain is one of the most densely populated countries in the world. The country is smaller than any of the 10 largest states in the United States. But it supports nearly one third as many people as live in the entire United States. Most of the people live in towns and cities in the region around London, in the Midlands, in the Lowlands of Scotland, and around Belfast in Northern Ireland.

The people of England, Scotland, Wales, and Northern Ireland are bound by many ties. They have lived together under the same government for more than 200 years. The British Crown symbolizes their unity.

The Welsh, the Scots, and the Irish are more closely related to the Celts than the English are. Each group has many traditions and customs of its own. The Welsh

GREAT BRITAIN AND THE SEA



British Information Services; Gendreau

British Seamen and Ships won greatness for their country. Great Britain depends on its fleet for protection and its merchant fleet for food and raw materials. British shipyards launch hundreds of vessels each year.

language is still spoken in many parts of Wales, and is being revived. The Scots speak English with so many changes in accent and vocabulary that the Scottish dialect is almost a separate language. Many regions of England, such as Yorkshire and Devon, also have local dialects. Northern Ireland has many English and Scottish families that settled there during the 1600's.

In 1801, three out of four of Great Britain's 10,500,000 people lived and worked on farms. Today, with nearly five times as many people, four out of five persons live and work in the cities. Of every 100 wage earners, 40 work in industry and only five farm the land. No other important country has so few farmers in relation to its total population.

For a description of ways of life in Great Britain, see **ENGLAND; NORTHERN IRELAND; SCOTLAND; WALES.**

Cities. London, the capital, is one of the world's largest cities. Belfast, Birmingham, and Manchester serve Great Britain as industrial centers. Liverpool, Bristol, and Glasgow are three of the world's most important seaports. See the separate articles on cities of Great Britain listed in the *Related Articles* section at the end of this article.

Manufactures. Great Britain is a leading producer of woolen and cotton textiles. British manufacturers also produce many synthetic fibers and fabrics. British clothiers make hand-tailored suits, coats, and other garments that are famous for their fine quality and workmanship. The woolen textile industry is centered in Yorkshire. Lancashire makes most of the cotton garments, and towns in Northern Ireland produce famous handmade linens. Most clothing is produced in London. Stockings come chiefly from Nottingham, and shoes from Northampton.

British factories turn out locomotives and other heavy railroad equipment. Factories in the Midlands produce heavy machinery that is used in all parts of the world.

Automobiles and trucks roll from plants near Coventry. British-made jets and turboprop airplanes fly for airlines of many nations.

In recent years, the British have developed large chemical, plastics, and fertilizer industries. British factories also turn out electrical goods, processed foods, glassware, paper, and leather and wood products. Printing and publishing are also important industries.

Great Britain is famous for its handicraft products. Fine porcelain and pottery come from Stoke-on-Trent and northern Staffordshire. Sheffield produces world-famous steel cutlery. Delicate precision instruments come from London and the Midlands.

Mining. Coal and iron ore form the backbone of Great Britain's industries. Only the United States and Russia produce more coal than Great Britain. The principal coal-mining areas include Tyneside, both sides of the Pennine Chain, and the Midlands, in England; southern Wales; and the Lowlands of Scotland. These fields have large reserves, and probably contain enough coal to last more than 200 years, at the present rate of digging. British miners dig about 224,000,000 long tons (2,240 lbs.) of coal every year. The coal industry employs more than 700,000 persons.

Many of the principal iron-ore deposits lie near coal fields, and provide raw materials for vast steel industries. Great Britain ranks next to the United States and Russia in steel production, and is fifth in mining iron ore. But the mines cannot provide enough iron ore, and Great Britain imports ore from Sweden and Spain.

British miners also dig tons of zinc, lead, tin, bauxite (aluminum ore), salt, and gravel and building stone from the earth every year.

Shipping is one of the largest and most important industries. Ships of British companies such as the Cunard-White Star Line, the Orient Line, and the Peninsular and Oriental Line sail to almost every port in the world. The British merchant fleet is the second largest in the world. Only the United States has a larger merchant fleet. British ships carry cargoes for many nations.

British shipyards build more than one third of the world's vessels. The *Queen Elizabeth*, the *Queen Mary*, and other ocean liners are British-built. The shipbuilding industry is concentrated in *Clydeside*, the district on the banks of the River Clyde in Scotland; in the Tyneside region of England; and around Belfast.

Agriculture employs only about one person out of 20 in Great Britain. The country has to import about half its food supply because of its small size and large population. This is one of the reasons that Great Britain is so dependent on its shipping industry. The eastern half of England is the principal farming region. This area produces grain crops, such as wheat. Other important crops include oats, rye, hops, vegetables, sugar beets, and fruits. In areas throughout the country where the land is not good for farming, farmers raise sheep, poultry, cattle, and pigs. Dairy farming is important in Wales, western England, the Scottish Lowlands, and Northern Ireland. Farmers in Scotland and Wales raise sheep for wool and meat.

Fisheries. About 27,000 British fishermen catch the sea food that forms an important part of the people's diet. In addition, many men and women work at preparing and marketing the fish. British fishing fleets ply the waters close to the island, as well as fishing grounds as far away as Iceland and Greenland. The Dogger Bank is one of the world's best fishing grounds. It is a large shallow area in the North Sea, between England and Denmark. British fishermen haul in about 1,000,000 tons of fish every year. The principal fishes caught include herring, cod, haddock, mackerel, plaice, halibut, and salmon. The British eat most of the fish, and export only a little. Billingsgate, in London, is the world's largest fish market. It handles about 600 tons of fish daily.

Atomic Energy. Great Britain is a world leader in the peaceful uses of atomic energy. The government has developed atomic-generated electric power. The world's first large-scale nuclear power station opened in 1956 in northwest England. Since that time, the gov-

ernment has built several other nuclear power stations.

Trade. Except for coal and iron ore, Great Britain must import most of the raw materials for its factories.

The United States, Commonwealth nations such as Canada and New Zealand, and other countries throughout the world buy British products. Great Britain has exported cotton, woolen, and silk fabrics since the 1800's. Today it also exports automobiles, aircraft, ships, machinery, processed foods, precision instruments, machine tools, and electrical goods and equipment. The United States and Canada buy electrical equipment, woolen cloth and clothing, chinaware, cutlery, and sports automobiles.

British imports from the United States and Canada include grain, tobacco, cotton, and petroleum. Great Britain buys foods, fats and oils, wood, raw wool and raw cotton, rubber, copper, and tin from other countries.

The value of Great Britain's imports is always greater than the value of its exports. Most of the difference is made up by what the country receives for services to other nations. For example, major sources of income are the British merchant fleet and the banking and insurance services that British companies sell to people and companies in many lands. Income from foreign loans and investments also helps pay for imports.

Transportation. When traveling in Great Britain, many visitors are confused because automobiles and trucks are driven on the left side of the street. The driver's seat of a British automobile is on the right side of the car, instead of the left side, as it is in cars made in the United States. *Lorries* (trucks), *trams* (streetcars), and buses are important means of transportation on the country's 200,000 miles of roads. A 72-mile expressway between London and Birmingham opened in 1959. It is the longest express highway in Great Britain.

A network of railroads which is more than 19,470 miles long covers Great Britain. The railroads use small



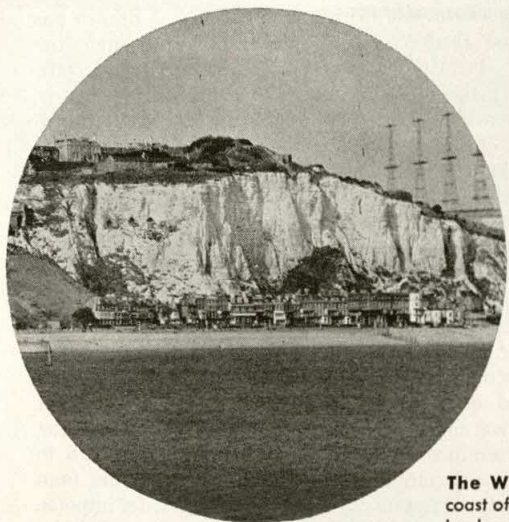
Capa, Pix; Gullers, Pix

Welsh Miners trudge through the early morning light to their work in the coal pits.

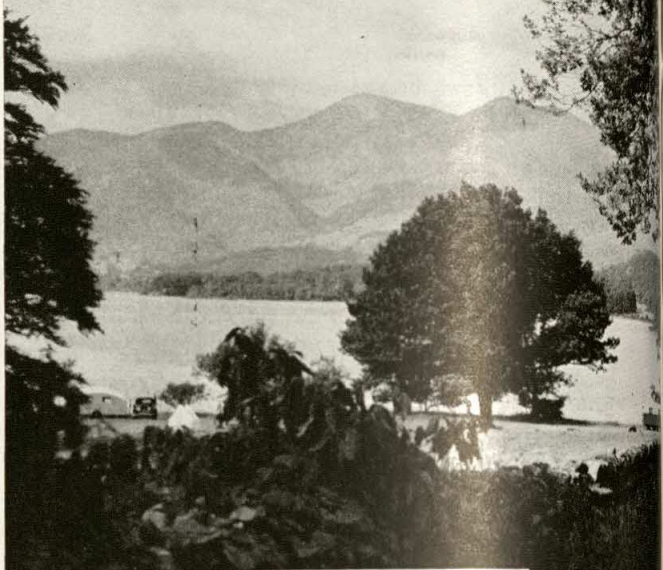
Farmers Pause for Rest while working in the fields of southwestern England. Neat hedgerows, sometimes 6 or 8 feet high, separate one rolling field from another.



FAMILIAR SIGHTS IN GREAT BRITAIN



The White Cliffs of Dover, rising sharply above the coast of the English Channel, have long been famous as a landmark for travelers and as a symbol of Great Britain.



Allan Cash, Rapho-Guillumette; Gendreau

The Lake Country of England has some of the loveliest scenery in the world. Thousands of visitors each year take trips to see clear blue lakes such as Derwentwater, near the town of Keswick.

freight cars, which are called *goods wagons*.

Rivers and waterways serve as important highways for trade. The Thames, with the Port of London, is the busiest river in Great Britain, and one of the busiest in the world. Second in importance is the River Mersey, flowing past Manchester and Liverpool. Great Britain has more than 2,400 miles of navigable waterways. The most important canal links Manchester with the Mersey (see MANCHESTER [Manchester Ship Canal]).

Air transportation is widely used. British planes flying abroad are operated by two public corporations, the British Overseas Airways Corporation (BOAC) and British European Airways Corporation (BEA). Large airports at London and at Prestwick in Scotland are main centers of international air traffic. Other important airports lie near Belfast, Birmingham, Edinburgh, Glasgow, Liverpool, Manchester, and Newcastle-on-Tyne. A helicopter freight service operates between London and Southampton. Helicopters also carry passengers from central London to London Airport.

Communication. The Post Office is a department of the Government. It not only provides mail service, but also is responsible for telephone and telegraph communication. Local post offices perform many government services. Here the people buy licenses to hunt, to own a dog or a gun, or to use a radio or a television set; pay government insurance premiums; and bank their savings in a postal savings system.

Radio and television are supervised by the Government. An independent public corporation, the British Broadcasting Corporation (BBC), handles all radio broadcasts. The BBC is financed by licenses that people must buy to use radio or television sets. There are no commercial sponsors for radio programs, and no radio advertising. The BBC also broadcasts television programs without advertisements. Another public cor-

poration, the Independent Television Authority (ITA), broadcasts commercial TV programs.

Government

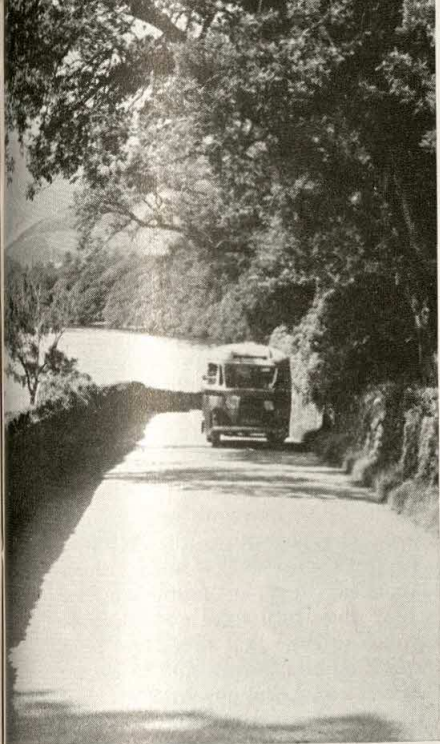
The Crown is the oldest state institution in Great Britain. *The Crown* refers to the powers and duties of the ruling monarch. It usually passes down from a king to his eldest son. If he has no sons, his eldest daughter inherits the throne. She becomes *queen regnant*, or reigning queen. Her husband usually holds the rank of *prince*, and she and Parliament decide what duties he will have in the Government. A king's wife is called his *queen consort*. She takes no part in the Government, and does not inherit the throne if her husband dies.

Queen Elizabeth II is the reigning queen. Her title is "Elizabeth the Second, by the Grace of God of Great Britain and Northern Ireland and of Her other Realms and Territories Queen, Head of the Commonwealth, Defender of the Faith." Her husband is Prince Philip, Duke of Edinburgh. Elizabeth II is a member of the *House* (family) of *Windsor* (see WINDSOR [family]).

The monarch reigns, but does not rule. Ministers of Parliament actually rule the country. Every act of state is performed in the name of the Crown. Government officials work "On Her (or His) Majesty's Service," often abbreviated as *O.H.M.S.* Coins and stamps bear a portrait of the monarch. The armed forces are called *royal*, and naval vessels bear the initials *H.M.S.*, for "Her (or His) Majesty's Ship."

The monarch is also head of the Church of England. The Crown appoints government officials, and names archbishops and other leaders of the Church of England. Most important of all, the Crown is a symbol of unity to the peoples of the entire Commonwealth.

Parliament actually governs Great Britain. It combines executive, legislative, and judicial duties and



Hunting, to the British, means fox hunting. Crowds gather to watch the red-jacketed Master of the Hounds prepare for the chase.



British Travel Assn.

powers. It is officially called *The Crown-in-Parliament*, and includes the monarch, the House of Commons, and the House of Lords. Both houses act on legislation. The king or queen approves an act before it becomes law, using the Norman French language of King Henry II.

The House of Commons is the real center of authority in the British Government. Its 630 members are elected by the people. England has 511 representatives in the House; Scotland has 71; Wales, 36; and Northern Ireland, 12. Each member represents a *constituency*, or district. But a member does not have to live in the district he represents. Members are elected for a maximum of five years at *general elections*. If a member dies or accepts a paying job from the Crown, a *by-election* is held in his constituency. The Prime Minister can ask the Crown to call a general election at any time, and many Parliaments do not last the full five years. Parliament also has the right to extend its own term of office in case of a great emergency, such as war.

All men and women over the age of 21 (except peers, criminals, and the mentally ill) have the right to vote. Any eligible voter (except clergymen of the established churches of England or Scotland; Roman Catholic clergy; and certain officers of the Crown) can be elected to the House of Commons. See HOUSE OF COMMONS.

The House of Lords has about 850 members. The number changes, because every *peer* (member of the nobility) in England automatically has a seat in the House of Lords. There are about 800 peers of the United Kingdom in Parliament. In addition, the House of Lords includes 16 peers elected from the peers of Scotland and five peers elected from the peers of Northern Ireland. The two archbishops of the Church of

England and 24 of the principal bishops also have seats in the House of Lords. They are called the *lords spiritual*. A number of *Lords of Appeal in Ordinary* (called *law lords*) hold seats in the House of Lords for life. The law lords act as the highest court of appeal.

The House of Lords was once the more important house of Parliament, but now it has little legislative power. It must pass all bills approved by the House of Commons for raising or spending money. After a year's delay, other bills may become law without the approval of the House of Lords. The monarch has the right to sit in the House of Lords without taking part in debate. But, by long tradition, the king or queen only comes to open Parliament. See HOUSE OF LORDS.

The Prime Minister is a member of Parliament. He is usually the leader of the majority party in the House of Commons. The monarch asks him to form a *cabinet* of ministers to run the Government. He consults his party leaders and gives the king or queen a list of men to head the various departments. The monarch always approves the leaders suggested. Some of the ministers may have Cabinet rank and some may not, but all must be members of Parliament. The Prime Minister lives in an official residence at No. 10 Downing Street in London, near the Houses of Parliament.

The Cabinet is made up of leaders of the majority party. The Prime Minister also has the title of First Lord of the Treasury. Actually the Chancellor of the Exchequer is responsible for financial matters. The Lord Chancellor is the highest legal officer in the country and also is Speaker of the House of Lords. Other important members of the Cabinet include the secretaries of state for Foreign Affairs, the Home Depart-

GREAT BRITAIN

ment, Colonies, Commonwealth Relations, and Scotland; the ministers of Defense, Labor, Education, Health, and Agriculture; and the President of the Board of Trade. The Cabinet varies in size, but usually has about 20 members.

The Cabinet draws up all major bills and introduces them in Parliament. Most government bills pass without difficulty. The House of Commons sometimes votes against the Government on an important issue in a *vote of no confidence*. When this happens, the Prime Minister usually resigns with his cabinet. Or he can ask the monarch to dissolve Parliament, so the people can decide the issue in a general election. In either case, the Cabinet and Parliament cannot disagree for long. They are both responsible to the people at all times. This is different from the United States Government, where the President may be of one party and one or both houses of Congress may be controlled by the other party.

Cabinet members are automatically members of the *Privy Council*. This group includes more than 300 members. It has no real governmental function, and usually meets only to attend formal ceremonies. But the Cabinet, in the name of the Crown, often issues *orders in Council* that have the force of law.

An important part of British cabinet government is the principle of *ministerial responsibility*. Each minister is responsible for the way his department functions, but the whole Cabinet supports him and shares his responsibility. When the Cabinet decides on a policy, or on advice to give the Crown, each minister supports it, even if he does not agree with it. He may be called on in Parliament to defend the policy. If he feels that he cannot agree with the majority of the Cabinet, he resigns. Unless he does so, he cannot claim later that he did not agree with, or approve of, the policy.

The Constitution of Great Britain is not one document, like that of the United States. The country does not have a single, complete, written constitution. The present form of government has developed over a period of more than 1,000 years. Each Parliament is legally free to make any law it wants. But there are certain basic traditions that no Parliament would set aside.

Great Britain's constitution comes from four main sources. These are (1) great charters, (2) acts of Parliament, (3) judicial decisions, and (4) customs and conventions. The charters include three basic documents:

The *Magna Carta*, which English nobles forced King John to grant in 1215, was the first limitation on the power of the king (see *MAGNA CARTA*).

The *Petition of Right*, in 1628, was the second great charter (see *PETITION OF RIGHT*).

The *Bill of Rights*, passed in 1689, assured constitutional government (see *BILL OF RIGHTS*).

The *Reform Bill* of 1832 made the House of Commons a more representative body than it had been, and the *Parliament Act* of 1911 limited the power of the House of Lords to defeat or delay acts passed by the Commons. These and other acts of Parliament, and every court decision in matters of common law, are part of the constitution. Faith in law and parliamentary government provide the basis for the British constitution.

Law Courts. Justice in Great Britain is based on *common law*. This system began in England during

the 1100's. Common law is made up of customs and *precedents*, or decisions of earlier judges in similar cases. Acts of Parliament have changed the common law in many ways, but its basic principles remain unchanged. Two important principles are that every man must be considered innocent until he is proved guilty, and that every man has the right to a jury trial. See *COMMON LAW*.

British court procedure is designed to uphold the dignity of the law. Judges are appointed by the Crown, on the recommendation of the Government, and they hold office for life. Thus they can be free from political influence. The House of Lords is the highest court of appeal in Great Britain. When it acts as a court, only the Lord Chancellor and the law lords take part. The law lords also belong to the Judicial Committee of the Privy Council, which hears cases appealed from British colonies and from some Commonwealth nations.

Local Government. The country is divided into *counties*, or *shires*. Several counties, such as Yorkshire, are divided into smaller areas for administration. Cities and towns have their own local governments. Some cities have grown so large that they have been made *county boroughs*. Counties, towns, and cities are governed by elected councils. Local governments have the power to collect *rates*, or taxes. A *Lord Lieutenant* and a *sheriff* represent the Crown in each county in Great Britain.

Political Parties. The most important British political parties today are the Conservative and Labour. The Conservatives, or Tories, favor preserving British traditions, and oppose most government control of industry. The Labour party favors some socialist goals, including the nationalization of basic industries and natural resources. The once great but now small Liberal party stands for a moderate approach to political problems. There are also some minor parties. See *CONSERVATIVE PARTY*; *LABOUR PARTY*; *LIBERAL PARTY*; *TORY*; *WHIG*.

Public Corporations. The British Government often acts through corporations in which it owns all or part of the stock. These corporations operate under government direction, but they set up their own policies and make their own decisions. The British Broadcasting Corporation, the British European Airways Corporation, and the British Overseas Airways Corporation are among such firms. Most British industries are privately owned. But the Government has taken over the railroads and the Bank of England. Some other industries, such as coal mining, and medical and dental services are *nationalized*.

There are no antitrust laws in Great Britain. The Government approves large combinations among shipping companies and large industries, as long as they do not operate against the public interest. These companies are not government-owned, but they work in cooperation with government authorities. The Government helps protect their foreign trade.

Currency. The unit of money in Great Britain is the *pound sterling*, or *pound*. There are 20 *shillings* in a

→
The Coronation of Queen Elizabeth II. The British enjoy the colorful pageantry and impressive ceremonies that go with their ancient traditions.

British Information Services



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pound, and each shilling is worth 12 *pence*, or pennies. Other coins include the *half crown* (two shillings and sixpence), the *florin* (two shillings) and the *sixpence*. £. stands for pound, s for shilling, and d for pence. These initials come from the Latin coin names *libra*, *solidus*, and *denarius* (see MONEY; PENNY; POUND STERLING; SHILLING).

Pounds, shillings, and pence are kept separate when writing prices. Two pounds, six shillings, and two pence is written £2/6/2. Seven shillings is written 7/-.

History

Union. The story of Great Britain begins during the reign of Queen Anne. England and Scotland had been ruled by the same kings for more than 100 years. But

RED-LETTER DATES IN GREAT BRITAIN

- 1707 The Act of Union joined England and Wales with Scotland to form Great Britain.
- 1713 The peace of Utrecht ended the War of the Spanish Succession, giving Gibraltar to Great Britain.
- 1757 Robert Clive defeated the Bengals at Plassey, leading to the British conquest of India.
- 1759 James Wolfe defeated the French at Quebec, beginning the British conquest of Canada.
- 1760-1770 The Industrial Revolution began in Great Britain with such inventions as the spinning jenny and the steam engine.
- 1775-1783 Great Britain lost the 13 American colonies.
- 1793-1802 Great Britain fought against the revolutionary government of France.
- 1800 The Act of Union joined Ireland to Great Britain.
- 1803-1815 Great Britain fought Napoleon and won the Battle of Waterloo.
- 1812-1814 Great Britain fought the War of 1812 with the United States.
- 1832 The First Reform Bill gave the vote to the middle classes and representation to factory towns.
- 1837-1901 Queen Victoria's reign brought prosperity and an expanding empire in Asia and Africa.
- 1899-1902 Great Britain fought the Boer War to win control of South Africa from Dutch colonists.
- 1911 The Parliament Act reduced the power of the House of Lords.
- 1914-1918 Great Britain fought in World War I, gaining former German colonies in Africa.
- 1926 The Imperial Conference recognized the independence and equality of the great dominions.
- 1931 The Statute of Westminster established the British Commonwealth of Nations.
- 1939-1945 Great Britain fought in World War II.
- 1945-1951 The Labour government nationalized many industries and set up a National Health Service.
- 1947-1949 India, Pakistan, and Ceylon became independent Commonwealth nations. Burma and Ireland left the Commonwealth.
- 1948-1954 Great Britain entered economic and defense alliances such as the North Atlantic Treaty Organization and Western European Union.
- 1951 The Conservative government denationalized some basic industries, such as iron and steel.
- 1954 Great Britain settled disputes with Egypt over the Suez Canal, and with Iran over oil rights.
- 1956 British troops left Egypt.
- 1957 Great Britain and Egypt gave the Sudan independence. Great Britain reorganized its armed services.
- 1958 Women were admitted to the House of Lords. Great Britain's first superhighway was opened.
- 1960 Great Britain granted independence to Cyprus and Nigeria.
- 1961 South Africa withdrew from the Commonwealth.

THE RULERS OF GREAT BRITAIN

NAME	REIGN	NAME	REIGN
House of Stuart		House of Saxe-Coburg-Gotha	
Anne	1702-1714	Edward VII	1901-1910
House of Hanover		House of Windsor	
George I	1714-1727	George V	1910-1936
George II	1727-1760	Edward VIII	1936
George III	1760-1820	George VI	1936-1952
George IV	1820-1830	Elizabeth II	1952-
William IV	1830-1837		
Victoria	1837-1901		

Each ruler listed has a biography in THE WORLD BOOK ENCYCLOPEDIA.

the two kingdoms quarreled many times. King William III wanted to unite them, but he died in 1702 before he could carry out his plans. Parliament passed the Act of Union in 1707, joining Scotland to England and Wales. The new kingdom was called Great Britain. Anne agreed to the union, first as Queen of Scotland and then as Queen of England and Wales, and the two kingdoms became one. For the history of Great Britain before 1707, see ENGLAND; SCOTLAND; WALES.

Hanover and Stuart. George I, a German prince of the House of Hanover, was Anne's second cousin. He was her closest Protestant relative, and became king when she died in 1714. He did not speak English, and had no real interest in the country. George took almost no part in government affairs, leaving everything in the hands of the Whig party. Sir Robert Walpole usually is considered the first Prime Minister of Great Britain. He led the Whigs in Parliament, and formed a Cabinet of ministers loyal to himself. See WALPOLE (Sir Robert).

Anne's brother James and the other Roman Catholic members of the House of Stuart were banished from Great Britain. When Anne died in 1714, James was on the Continent. He proclaimed himself James III, King of Great Britain. The British called him the *Old Pretender*. With the help of the Highland Scots, he led a rebellion in 1715, called *The '15*. But he was defeated and fled to France. His son Charles, who was called *Bonnie Prince Charlie* or the *Young Pretender*, tried again in 1745. His rebellion is called *The '45*. Highland Scots joined him and invaded England. But Charles' forces were crushed at Culloden Moor, and he fled to France.

The Growing Empire. George I's son became king in 1727 as George II. He did not speak much English, and paid little attention to national affairs. But Great Britain became one of the world's greatest colonial powers during his reign. The British won a series of victories in the Seven Years' War (1756-1763). The part of this conflict that was fought in North America is called the French and Indian War. In another phase of the war, Robert Clive defeated the Bengals and assured British power in India by winning the Battle of Plassey. Clive led the forces of the British East India Company in several other campaigns. Two years later, in 1759, James Wolfe defeated the French at Quebec and won control of Canada for Great Britain. The British Navy took islands in the West Indies and settlements in Africa. When the war ended in 1763, Great Britain controlled North America from the Atlantic Ocean to the Mississippi River. See EAST INDIA COMPANY; FRENCH AND INDIAN WARS; SEVEN YEARS' WAR.

William Pitt the elder, often called the *Great Com-*

moner, led the Whig opposition to Walpole's Government. The Whigs won control of Parliament in 1756, and Pitt was largely responsible for Great Britain's success in building colonies. Its most important colonies at this time were the 13 American colonies, Canada, islands in the Caribbean Sea, and settlements in India. George III came to the throne in 1760, determined to rule as well as reign. Pitt was forced to resign in 1761.

The Revolutionary War in America. George III worked to keep Prime Minister Lord Frederick North and the Tories in power. But he was stubborn, and would not let his ministers oppose him. The Government often mismanaged relations with the colonies.

The King decided that the American colonies should help pay the huge debt caused by the Seven Years' War. The Government prepared to collect new taxes by force. The colonies refused to pay, asserting that "taxation without representation" in Parliament was unjust, and war began. France took the side of the colonists. The Whigs, led by the younger William Pitt, opposed the long war. The fighting ended when Lord Charles Cornwallis surrendered at Yorktown, and North resigned as Prime Minister. The Whigs returned to power and recognized the independence of the United States. The loss of the American colonies was a blow to British prestige. Soon afterward, the British began making other settlements. See **REVOLUTIONARY WAR IN AMERICA**.

The Industrial Revolution greatly changed the lives of the British people in the 1700's. Great Britain became the world's first important industrial nation. New machines in factories produced more goods than hand methods could produce in homes. Inventions such as the steam engine in 1769 made better machines possible. Coal mines expanded to provide fuel for factories. Industries grew up where coal and iron ore lay close together. Steamships and steam railways began operating in the early 1800's. See **INDUSTRIAL REVOLUTION**.

Wealthy landowners began to buy pastures and fields that villagers had used together for hundreds of years. The landowners fenced in the fields, and experimented with new farming methods. This *enclosure* movement put many farm laborers out of work, so they moved to the towns and found work in new factories. Industrial cities such as Birmingham and Manchester grew rapidly.

Wars with France. The French Revolution broke out in 1789 (see **FRENCH REVOLUTION**). Great Britain went to war with France in 1793, because the French had taken the area that is now Belgium and threatened to conquer other areas. After 13 months of peace in 1802 and 1803, war broke out again. Admiral Lord Horatio Nelson won a great victory over the French fleet at Trafalgar, off the southern coast of Spain, in 1805.

Great Britain and its allies, including Prussia and Russia, finally defeated the French on land in 1814 and sent Napoleon into exile on the island of Elba (see **NAPOLEON I**). But, after 11 months of peace, Napoleon escaped and started the war again. An allied army led by the Duke of Wellington defeated Napoleon at Waterloo, ending the long series of wars (see **WATERLOO, BATTLE OF**). In Europe, Great Britain won the island of Malta from France. The British also won French territories from the Cape Colony in South Africa to Ceylon, and islands in the Caribbean Sea.

Revolt in Ireland began during the wars with France. The English had governed Ireland from the 1200's, and

the British monarch held the title *King of Ireland*. But the Irish never really accepted English rule. In the late 1700's, British leaders decided to make Ireland part of the United Kingdom. The British Parliament passed an Act of Union in 1800. Most of the Irish were Roman Catholics, and British laws at that time kept Catholics from voting or holding public office. These laws were changed in 1829 to give the Catholics equal political rights. See **IRELAND (History)**.

The Era of Reform. During the 1780's, the younger William Pitt introduced bills in Parliament to reform the voting system. At that time, only the wealthy upper classes could vote. Many districts that sent two members to Parliament had only a handful of voters, and the growing industrial cities had almost no representation at all. But the reform measures were defeated and forgotten during the wars with France.

These wars, and the depression that followed them, only made the situation worse. Unemployment spread, particularly in factory towns. Earnings fell, and many farmers could not pay their rents. The Government passed a Corn Law in 1815 to regulate imports of food grain (called *corn* in Great Britain). Prices rose, and many poor workers faced starvation. Great Britain faced revolution when William IV took the throne in 1830.

The Whigs saw reform as a way to break the power of the Tories. They prepared a bill that gave middle-class people with certain property qualifications the right to vote. The bill also abolished several *rotten boroughs*, or districts with few, if any, votes. Lord John Russell, leader of the Whigs, introduced a Reform Bill in 1831. The House of Commons finally passed the third version of the bill in 1832. The House of Lords planned to reject the bill, and the Whigs resigned. But the Tories could not form a Cabinet that Parliament would support. Pressed by the Whigs, William IV threatened to name enough new lords to provide a majority for the bill, and the House of Lords finally passed it.

The first Parliament elected under the Reform Bill made slavery illegal in Great Britain's colonies in all parts of the world. It also improved child labor laws and set up safety inspection laws for factories.

The Reign of Victoria began in 1837, when she was only 18. The British Empire reached its greatest power during her reign. Many outstanding Prime Ministers led the Government while Victoria was queen.

Sir Robert Peel abolished the Corn Laws in 1846, taking an important step toward Great Britain's later policy of free trade. He also founded London's Metropolitan Police and Ireland's constabulary. A British policeman is often called a *Bobby* or a *Peeler*.

Henry Temple, Lord Palmerston, led the Government in the Crimean War of 1854-1856 (see **CRIMEAN WAR**). After the Sepoy Rebellion in India, Palmerston's government took control of India and abolished the East India Company (see **SEPOY REBELLION**).

Benjamin Disraeli was responsible for the Reform Bill of 1867. This bill gave many factory workers the right to vote. Disraeli also represented Great Britain at the Congress of Berlin, called to settle problems after the Russo-Turkish War (see **BERLIN, CONGRESS OF**).

William Gladstone led Parliament in passing the third Reform Bill in 1884. This bill lowered property

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qualifications for voting so that all men over 21 could vote. It also divided the country into more equal voting districts. After Gladstone's death, Parliament won support for the Boer War, from 1899 to 1902, which assured British control of South Africa (see **BOER WAR**).

The question of home rule for Ireland arose again in the late 1800's and early 1900's. Gladstone wanted to give the Irish self-government, but the House of Commons refused to pass his first Home Rule Bill in 1886. The Lords rejected his second bill in 1893 (see **HOME RULE**). Queen Victoria did not like Gladstone, and she was pleased when he resigned.

PRIME MINISTERS OF THE 1900's

NAME	DATES SERVED	PARTY
Marquis of Salisbury	1895-1902	Conservative
Arthur J. Balfour	1902-1905	Conservative
Sir Henry Campbell-Bannerman	1905-1908	Liberal
Herbert H. Asquith	1908-1916	Liberal
David Lloyd George	1916-1922	Liberal
Andrew Bonar Law	1922-1923	Conservative
Stanley Baldwin	1923-1924	Conservative
J. Ramsay MacDonald	1924	Labour
Stanley Baldwin	1924-1929	Conservative
J. Ramsay MacDonald	1929-1935	Labour
Stanley Baldwin	1935-1937	Conservative
Neville Chamberlain	1937-1940	Conservative
Winston Churchill	1940-1945	Conservative
Clement R. Attlee	1945-1951	Labour
Winston Churchill	1951-1955	Conservative
Sir Anthony Eden	1955-1957	Conservative
Harold Macmillan	1957-	Conservative

Each Prime Minister has a biography in **THE WORLD BOOK ENCYCLOPEDIA**.

Life in Great Britain changed greatly during Victoria's long reign. Roads and railroads spread across the country, and telephone and telegraph lines linked important cities. The population more than doubled. The middle class prospered, and the poorer people were probably more comfortable than they had ever been.

During Victoria's reign, Great Britain produced some of its greatest novelists, including Charles Dickens, Thomas Hardy, and Robert Louis Stevenson, and great essayists such as John Henry Newman, Walter Pater, and John Ruskin.

World War I grew out of troubles in the Balkans. But another cause was the growing strength of the German Empire. German industry was developing faster than British factories. Germany also built a navy and talked of seizing colonies in many parts of the world.

France, Germany, Great Britain, and other nations had agreed in 1830 that Belgium should always be neutral. But German armies invaded Belgium in 1914 to attack France. Great Britain declared war on Germany, Austria-Hungary, and Turkey. Other nations, including the United States, joined the war on the side of the Allies, and Germany was defeated (see **WORLD WAR I**). During the war, George V changed his family name from Saxe-Coburg-Gotha to Windsor. Prime Minister David Lloyd George led Parliament during the war and represented the country at the Versailles peace conference. Great Britain received League of Nations mandates over former Turkish possessions in the Near

East and German colonies in Africa (see **IRAQ**; **MANDATED TERRITORY**; **PALESTINE**).

Great Britain lost more than 900,000 men in World War I, and about 2,100,000 were wounded. Submarines sank about 7,700,000 tons of British shipping.

Postwar Problems. The British lost valuable markets for coal, ships, machinery, and cotton and woolen cloth during World War I. When the war ended, factories that had made military goods closed, and many workers lost their jobs. The peace treaties caused many new problems in other countries, and the Government had to station British troops in Turkey, Egypt, and Palestine. India began to demand independence.

Ireland remained a source of trouble. Irish leaders elected to Parliament in 1918 refused to go to London. They set up their own assembly in Dublin, representing all southern Ireland. Northern Ireland accepted a Home Rule Bill passed by the British Parliament in 1919, and remained in the United Kingdom. Finally, Great Britain recognized southern Ireland as a separate dominion, the Irish Free State.

Many changes took place in the British Government during the postwar period. In the last months of the war, Parliament passed a bill giving women the right to vote. The new Labour party, led by J. Ramsay MacDonald, took office for nine months in 1924. MacDonald became Prime Minister again in 1929.

The Government helped set up a system of power lines to sell electric power cheaply throughout the country. In new areas, such as Coventry, industries grew up that produced automobiles, electrical equipment, and other new goods. But old industrial areas in the north and Midlands had thousands of unemployed workers, most of them coal miners, textile workers, and shipbuilders. A world depression began in 1929. By 1931, about one of every four British workmen had no job.

MacDonald formed a cabinet of Labour, Conservative, and Liberal party leaders to deal with the emergency. Great Britain went off the gold standard and gave up its policy of free trade. The Government increased taxes and cut its own spending.

The British Empire became the British Commonwealth of Nations in 1931. Statesmen at the Imperial Conference in London in 1926 had declared that the Commonwealth nations of Australia, Canada, Ireland, New Zealand, South Africa, and the United Kingdom should have equal status. The Parliaments of Great Britain and the dominions put this principle into law by passing the Statute of Westminster in 1931. See **BRITISH COMMONWEALTH OF NATIONS**; **BRITISH EMPIRE**.

"Peace for Our Time." Adolf Hitler won control of Germany in 1933 and began to rearm the country. But Stanley Baldwin, who became British Prime Minister in 1935, was slow to realize the danger to Great Britain.

King George V died early in 1936. His popular son came to the throne as Edward VIII. But he wanted to marry an American divorcee, Mrs. Wallis Warfield Simpson. The Government, the Church of England, and the public opposed the marriage. Edward gave up the throne before his coronation to marry "the woman I love," and his brother became king as George VI.

Neville Chamberlain became Prime Minister in 1937. He pleaded for "peace for our time," and shut his eyes to the aggressions of Germany, Italy, and Japan. Most of the British people supported Chamberlain's policies.

In 1938, Hitler demanded part of Czechoslovakia. To prevent war, Chamberlain flew to Munich and agreed to Hitler's demands (see MUNICH AGREEMENT). But Hitler seized the rest of Czechoslovakia in March, 1939. Great Britain finally began to arm.

"Their Finest Hour." World War II began in Europe on September 1, 1939, when Germany invaded Poland. In 1940, German troops overran western Europe. Chamberlain resigned, and Winston Churchill became Prime Minister. In a stirring speech, he promised the British people only "blood, toil, tears, and sweat" in a war to the bitter end. France fell in June, and Great Britain faced Germany and Italy alone. See WORLD WAR II.

The British prepared for an invasion at any moment. They tore down street signs and destroyed direction markers to confuse enemy paratroops. German air raids damaged many British cities in the Battle of Britain from September, 1940, to May, 1941. Churchill inspired the people by telling them that this was "their finest hour." Parks, lawns, and grazing areas were planted with food crops. Severe rationing gave every person his share of foods, but milk, eggs, fresh meat, and fruits became scarce. In London, many people slept in subway stations and underground shelters. There was a strict blackout, and the only lights at night came from anti-aircraft guns and burning buildings hit by German bombs.

Germany attacked Russia, and Japan attacked United States possessions in 1941. Both countries entered the war. The Allies stopped German and Japanese advances the next year. In June, 1944, American and British forces invaded France. Germany surrendered on May 7, 1945. At the same time, Allied forces prepared to invade Japan. But an American bomber dropped the first atomic bomb, on Hiroshima, Japan, in August, and the conflict ended quickly.

Great Britain lost about 360,000 men in World War II. About the same number were wounded, and some 145,000 civilians died on the home front. The country piled up huge debts to other countries.

A Labour Government swept to power with a social-list program at elections in July, 1945. Clement Attlee, Labour party leader, became Prime Minister. During the next six years, the Government nationalized the Bank of England, the coal mines, the iron and steel industry, the railroads, road transportation, and public utilities. A social security system "from the cradle to the grave" became law in 1948. It provided free medical and dental service, and insurance benefits for all.

Great changes took place in the Commonwealth after World War II. India and Pakistan became independent countries within the Commonwealth in 1947, and Ceylon, in 1948. Burma became an independent nation outside the Commonwealth the same year. In the Near East, Great Britain gave up its League of Nations mandate over Palestine, and the new state of Israel was born. Ireland left the Commonwealth in 1949.

Great Britain became a leader of the free world in the fight to stem Communism. It helped form the North Atlantic Treaty Organization (NATO) in 1949, and the Southeast Asia Treaty Organization (SEATO) in 1954. It took part in the various plans to unite western Europe, and joined with Commonwealth nations in sponsoring the Colombo Plan for economic cooperation in 1950. British troops fought in Korea (see KOREAN WAR). The United States maintained 17 air force bases in England.



Gullers

Many Buildings in Britain, such as these in Chester, show the influence of the half-timbered construction of Tudor England.

Diplomatic problems arose in the Near East in 1951. Iran's Government voted to nationalize the British-owned Anglo-Iranian Oil Company. Later in the year, Egypt denounced the Anglo-Egyptian alliance of 1936 and demanded that British troops withdraw from the Suez Canal Zone and from the Sudan.

The Labour Government improved Great Britain's difficult economic position only slightly, even with financial aid from the United States. In September, 1949, the British cut the value of the pound from \$4.03 to \$2.80. But the nation spent more money in world markets than it earned, and devaluation of the pound raised prices on the British home market.

Winston Churchill and the Conservatives returned to power in October, 1951. They restored the iron and steel and trucking industries to private ownership.

Elizabeth II came to the throne when her father, George VI, died in February, 1952. Thousands of people lined London's streets on June 2, 1953, to watch the coronation procession.

In 1954, Great Britain settled a Suez Canal dispute with Egypt and an oil dispute with Iran. British oil companies agreed to operate Iran's oil industry and to give Iran half the profits. Under the agreement with Egypt, Great Britain agreed to give up control of the Suez Canal Zone, and evacuated British troops by June, 1956. In another agreement, the two countries gave the Sudan independence in January, 1956.

On April 5, 1955, Sir Winston Churchill resigned as Prime Minister. Sir Anthony Eden, who had been Foreign Minister, took his place. In October, 1956, Great Britain, France, and Israel attacked Egypt after Egypt nationalized the Suez Canal. United Nations pressure and fear of Russian intervention ended the fighting in November. But, with oil shipments disrupted, an economic crisis struck Great Britain. On

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Jan. 9, 1957, Eden resigned as Prime Minister and was succeeded by Harold Macmillan.

In 1958, Vivian Fuchs, a British explorer, made the first land journey across Antarctica. Queen Elizabeth II signed the Life Peerage Act in 1958, permitting women to become members of the House of Lords for the first time. In 1959, the Conservatives won a majority in Parliament for the third straight time since 1951. Queen Elizabeth gave birth to her third child, a son, in February, 1960. Nigeria and Cyprus received their independence. The next year, South Africa withdrew from the British Commonwealth.

FRANCIS H. HERRICK

Related Articles. For the ways of life and social and cultural achievements of Great Britain, see the sections on these topics in ENGLAND; NORTHERN IRELAND; SCOTLAND; WALES. See also the following articles:

BIOGRAPHIES

There is a separate biography of each ruler and prime minister who is listed in the tables in the *History* section. Lists of biographies of other famous Britons appear under the headings England, Northern Ireland, Scotland, and Wales in the BIOGRAPHY section of the READING AND STUDY GUIDE.

BATTLES AND WARS

Balaklava, Battle of	Sepoy Rebellion
Bering Sea Controversy	Seven Years' War
Boer War	Succession Wars
Crimean War	Trafalgar
French and Indian Wars	War of 1812
Korean War	Waterloo, Battle of
Louisbourg	World War I
Revolutionary War in America	World War II

CHIEF CITIES

Belfast	Edinburgh	Liverpool	Sheffield
Birmingham	Glasgow	London	
Bristol	Leeds	Manchester	

GOVERNMENT

British Commonwealth of Nations	Magna Carta
Cabinet	Mandated Territory
Constitution	Nobility
Exchequer	Order in Council
House of Commons	Parliament
House of Lords	Prime Minister
Imperialism	Privy Council
	Privy Seal

HISTORY

British Empire	Junius Letters
Chartism	London Company
Corn Laws	Navigation Act
Industrial Revolution	Test Act
Ireland (History)	Windsor (family)

PHYSICAL FEATURES

Avon, River	Humber, River	Scilly Islands
Ben Lomond	Inchcape Rock	Severn, River
Ben Nevis	Irish Sea	Shetland Islands
Bristol Channel	Land's End	Snowdon
Channel Islands	Loch Katrine	Tay, River
Clyde, River	Loch Lomond	Thames, River
Dartmoor	Loch Ness	Trent, River
Dee, River	Lough Neagh	Trossachs
Derwent, River	Man, Isle of	Tweed, River
Doon, River	Mersey, River	Wash, The
Dover, Strait of	Minch, The	Wight, Isle of
English Channel	Pennine Chain	Windermere
Firth of Clyde	Saint George's Channel	Lake
Firth of Forth		

PRODUCTS

For Great Britain's rank among other countries in production, see the following articles:

Barley	Iron and Steel	Paper
Coal	Leather	Potato
Fishing Industry	Manufacturing	Publishing

TREATIES AND AGREEMENTS

Alabama (ship)	League of Nations
Berlin, Congress of	Locarno Conference
Central Treaty Organization	North Atlantic Treaty Organization
Clayton-Bulwer Treaty	Southeast Asia Treaty Organization
Colombo Plan	Trent Affair
Europe, Council of	Triple Entente
European Monetary Agreement	United Nations
Ghent, Treaty of	Vienna, Congress of
Hay-Pauncefote Treaty	Webster-Ashburton Treaty
Jay Treaty	

UNCLASSIFIED

Army (Major Armies)	John Bull
Bank of England	Lloyd's
British Museum	Navy (Major Navies)
Christmas (In Great Britain)	Royal Household of Great Britain
Clothing (color pictures)	Ship and Shipping (table)
Crown	Victoria Day
English Literature	Woman (In Great Britain)
Firth	
Gibraltar	
God Save the Queen	

Outline

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C. Manufactures	J. Transportation
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D. The Cabinet	J. Currency
E. The Constitution	
IV. History (after 1707)	

Questions

Which is closer to the North Pole, Great Britain or the state of Minnesota?

Why does Great Britain have a milder climate than the northern United States?

How does Great Britain rank in size among the world's islands?

What two minerals are most important to Great Britain's industries?

Who was the *Great Commoner*? *The Old Pretender*?

Where is the largest fish market in the world?

What are the great documents of British freedom?

Why is Great Britain so dependent on its merchant marine fleet?

What is *ministerial responsibility*? A *goods wagon*? *The continental shelf*? *Cabinet government*?

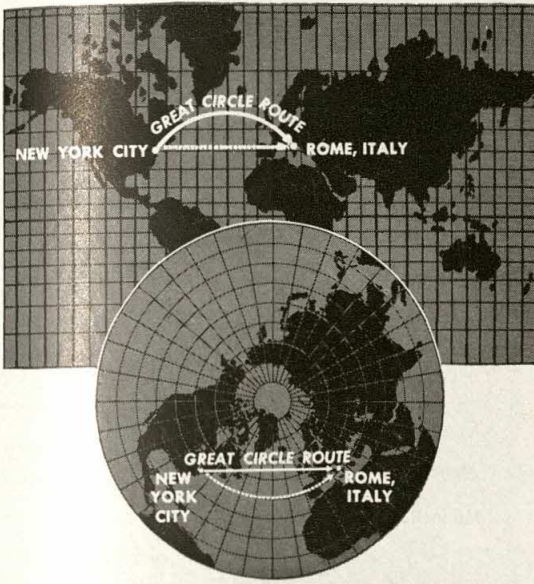
What is the real center of authority in the British government?

Who controls radio and television in Great Britain?

What were the *Corn Laws*? *The '15* and *'45*?

Why is it true that the monarch reigns, but does not rule in Great Britain?

GREAT CHARTER. See MAGNA CARTA.



A Great-Circle Route, solid line, gives the shortest distance between New York City and Rome. A globe or aviation map shows this clearly, but a flat Mercator map does not.

GREAT-CIRCLE ROUTE is a term used in navigation. It means a route or course which follows the true circumference of the earth between two points. If an orange is sliced exactly in half in any direction, the edge of the cut forms a great circle. This edge becomes the shortest surface route between any two points through which it passes.

Because the great-circle route is the shortest distance between any two points on the earth, it is of great importance to both ship and airplane navigators. Airplanes particularly use the great-circle route, because they do not have to avoid land. They can fly straight over both land and sea on the great-circle route. See **AVIATION** (color map).

The surface of a sphere is made up of an infinite number of circles, each with its center at the sphere's center. Each is the greatest possible circle which can be drawn on the surface of the sphere. A great circle's circumference, radius, and diameter equal exactly the sphere's circumference, radius, and diameter. Other circles can be drawn but they are smaller circles. Being smaller, their circles curve more than is necessary to move from one point to another on a sphere.

A great circle cannot be traced exactly on a flat map because the surface of a globe is not accurate when it is pressed flat. A globe must be used. The globe is used with a device called a *distance-finder cradle*, or with another device called a *spherimeter*. The cradle is a circular band exactly the size of the globe.

The globe is turned until the two points being routed lie along the band. The spherimeter has two flat planes, of wood, metal, or cardboard. Both have one side cut out to fit the globe exactly and reach halfway around, or 180 degrees. They are joined in their centers at right angles to each other and fitted on the globe. One of the planes has degrees marked on one side and miles on the other. The zero marker is placed on one point and the

spherimeter is slid around the globe until the other point lies along the same plane. The direction is traced by marking along the plane. The distance can be read both in degrees and in miles.

JOHN J. FLOHERTY

See also **NAVIGATION**.

GREAT COMMONER is a nickname that has been given in the past to such public figures as William Jennings Bryan and Thaddeus Stevens in the United States, and to William Pitt and William E. Gladstone in England. Each earned the name through his championship of the rights of the common man. Each of these men has a separate article in **WORLD BOOK**.

GREAT DANE is a large dog, noted for its strength and its handsome, proud appearance. The great Dane is a smooth or shortcoated breed of the mastiff family. It stands about 30 inches high at the shoulder, and weighs from 120 to 150 pounds. Great Danes vary in color. They may have different shades of tan (fawn), brown with black stripes (brindle), white with black spots (harlequin), blue, or black. It is the custom to trim, or crop, the dog's ears. The great Dane is perhaps the most graceful of all large dogs. It has a good temper, is obedient, and makes a quiet watchdog. See also **DOG** (color picture, Working Dogs); **MASTIFF**. HENRY P. DAVIS

GREAT DIVIDE, or **CONTINENTAL DIVIDE**, is the highland in North America that separates the waters flowing into the Atlantic Ocean from those flowing into the Pacific. In the United States and Canada, the Great Divide is high in the Rocky Mountains. It crosses New Mexico, Colorado, Wyoming, Idaho, Montana, British Columbia, and Alberta. In Canada, it joins the Height of Land, which separates Pacific and Arctic drainage on the west from Arctic and Atlantic drainage on the east. The Great Divide also runs through Mexico and Central America.

JOHN H. GARLAND

See also **DIVIDE** (picture).

GREAT DOG. See **CANIS MAJOR**.

GREAT EASTERN was the name of the British steamship used to lay the Atlantic Cable. The *Great Eastern*, built in 1859, weighed 18,915 gross tons, and for many years was the largest ship afloat. See also **CABLE**.

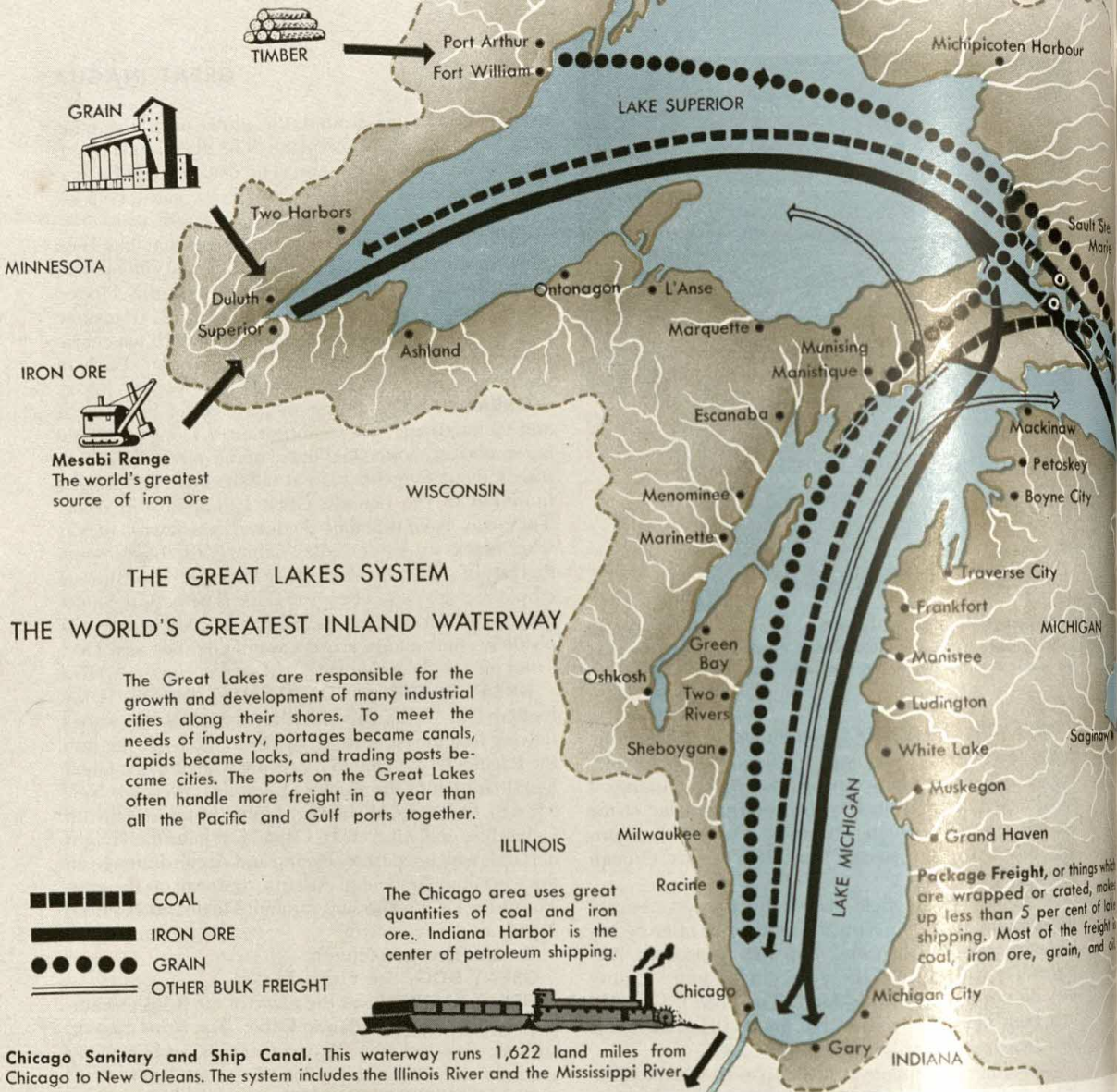
GREAT ELECTOR. See **FREDERICK WILLIAM**.

GREAT EXUMA. See **BAHAMAS**.

GREAT FALLS, Mont. (pop. 55,357; alt. 3,330 ft.), a commercial center and the largest city in the state, is about 95 miles northeast of Helena. For location, see **MONTANA** (color map). It lies near the falls of the Missouri River, and was named for them. They furnish power for hydroelectric plants. Industries in Great Falls include copper, zinc, and petroleum processing; printing and publishing; meat packing; the production of wire products; and flour milling. Great Falls is the home of Malmstrom Air Force Base. Paris Gibson founded Great Falls in 1883, and it became a city in 1888. The seat of Cascade County, it has a mayor-council form of government. DONALD H. WELSH

GREAT FALLS, COLLEGE OF, is a liberal arts and teacher-training college at Great Falls, Mont. It was founded in 1932, and is a privately controlled Catholic institution. Courses offered include science, social work, humanities, nursing, and medical technology. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GREAT INAGUA. See **BAHAMAS**.



GREAT LAKES. Lakes Superior, Michigan, Huron, Erie, and Ontario—the five Great Lakes—are the largest group of fresh-water lakes in the world. They make up the most important inland waterway in North America. These lakes were the chief route used by early explorers and settlers of the Northwest Territory. Later, the cheap transportation offered by the Great Lakes turned this territory into one of the most important industrial areas in the United States.

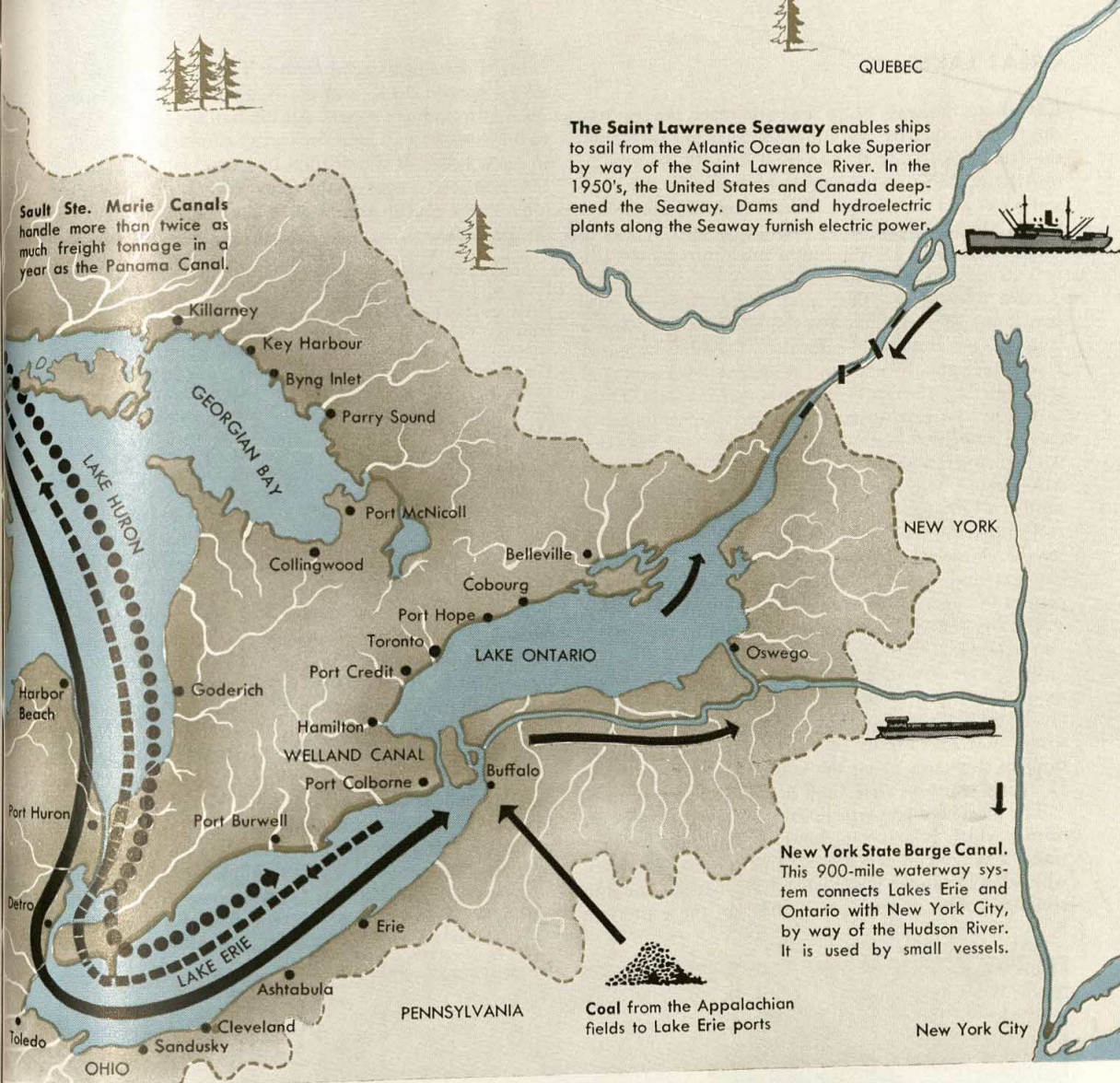
Of the five lakes, only Lake Michigan lies entirely within the United States. The other four lakes are shared by the United States and Canada, and form part of the boundary between the two countries. The Boundary Waters Treaty of 1909 provides joint control of the lakes by these two countries. Among the chief lake ports are Chicago, Milwaukee, and Gary on Lake Michigan; Buffalo, Cleveland, Toledo, and Ashtabula on Lake Erie; and Duluth and Superior on Lake Superior. Other chief ports include Detroit, which lies on a river con-

necting Lake Huron and Lake Erie, and Toronto, a Canadian port on Lake Ontario.

Size and Elevation. The combined area of these lakes is 94,710 square miles. This is more than the total area of the six New England states. Lake Superior is the largest of the lakes. It is a little smaller than the state of Maine and a little larger than South Carolina. Next in size is Lake Huron, which is almost as large as West Virginia. Lake Michigan has an area equal to the combined areas of Maryland, Massachusetts, and Delaware. Lake Erie, the shallowest of the Great Lakes, is about the size of Vermont. Lake Ontario is the smallest of the Great Lakes. It is not quite so large as New Jersey.

There is a great difference in the water levels of the lakes. Lake Superior lies 602 feet above sea level, and Lake Ontario lies 247 feet above sea level. The greatest change in water levels between one lake and the next one is the 326-foot drop from Lake Erie to Lake Ontario.

Drainage. The Great Lakes drain a comparatively



small area. Many streams empty into the lakes, but they are all very small. At one time all the water in the lakes drained into the Saint Lawrence River. Today, some of the water goes down the Chicago River. The course of this river was turned away from Lake Michigan in 1900 when the Chicago Sanitary and Ship Canal was opened. The valleys drained by the lakes lie on the southern slope of a height of land which extends across the North American continent from ocean to ocean. The area drained on the north of the Great Lakes slopes toward Hudson Bay. The area drained on the south slopes toward the Gulf of Mexico.

Water Routes to the Sea. Some of the Great Lakes ports are more than 1,000 miles inland, but ships can sail from any of these ports to any other port in the world. This has been made possible by three great sets of canals and locks built by the governments of the United States and Canada. These canals often correct differences in water levels of the lakes. The difference

in water levels is easily seen at Niagara Falls.

One set of canals, which together are called the *Welland Canal*, lies a few miles west of the Niagara River, and connects Lake Erie and Lake Ontario. Ships sail from Lake Erie into Lake Ontario, down the Saint Lawrence River, and on into the Atlantic Ocean.

Another set of canals is called the *Soo*, or *Sault Sainte Marie, Canals*. These canals are on the Saint Marys River, which connects Lake Superior and Lake Huron. The Sault Sainte Marie system was built around rapids which occur at a 20-foot drop in the Saint Marys River. The route to the sea is from Lake Huron to Lake Erie, to Lake Ontario, down the Saint Lawrence to the Atlantic.

A third canal group is the Saint Lawrence Seaway, officially opened in June, 1959. The Seaway's system of canals and locks stretches for 182 miles from Montreal, Que., to Iroquois, Ont., and permits ocean-going ships to sail from the Atlantic to Lake Superior. See SAINT

GREAT LAKES

LAWRENCE SEAWAY. Ships may also reach the sea from the Great Lakes by two other routes. One is through the New York State Barge Canal from Buffalo, N.Y., to Albany, N.Y., connecting Lake Erie with the Hudson River and the Atlantic Ocean. Another takes ships from Lake Michigan to the Gulf of Mexico by way of the Chicago Sanitary and Ship Canal, through the Illinois River, and down the Mississippi.

Lake Commerce. More than twice as much shipping tonnage passes through the Soo Canals during a year as goes through the Panama Canal. The Great Lakes have greatly aided the industrial development of the United States, especially in the steel industry. These waterways provide a quick route by which iron ore is carried from the ports of Duluth and Two Harbors, Minn., Superior and Ashland, Wis., and Escanaba and Marquette, Mich., to the steelmaking centers in northern Indiana, Ohio, and Pennsylvania.

The lakes also offer the best means of transportation for the shipment of the huge wheat crops of western Canada and the northern United States to milling centers in eastern Canada and at Buffalo, N.Y. Other ships carry coal, flour, copper, and manufactured goods on the lakes.

Ice covers the lake harbors and straits for several months during the winter. Storms whip up high waves on the wide waters, and ships using the lakes must be strong and safe. Many of the Great Lakes ships are built in shipyards along the lakes. During World War II, many warships were built at these shipyards.

The most common type of ship on the lakes is the *ore carrier*, which is a special kind of ship built for lake trade. The ore carrier is a long, awkward-looking craft, which lies low in the water when fully loaded. The ship contains cabins at its extreme ends. In the center are

covered openings, called *hatches*. The ship pulls alongside a special dock, and ore is poured into the open hatches from huge spouts. All the hatches can be filled at the same time. A large ore carrier can be loaded within a few hours. It is unloaded by giant electric shovels. On their return trips on the Great Lakes, the ore boats often carry coal in the hatches and new automobiles on the decks.

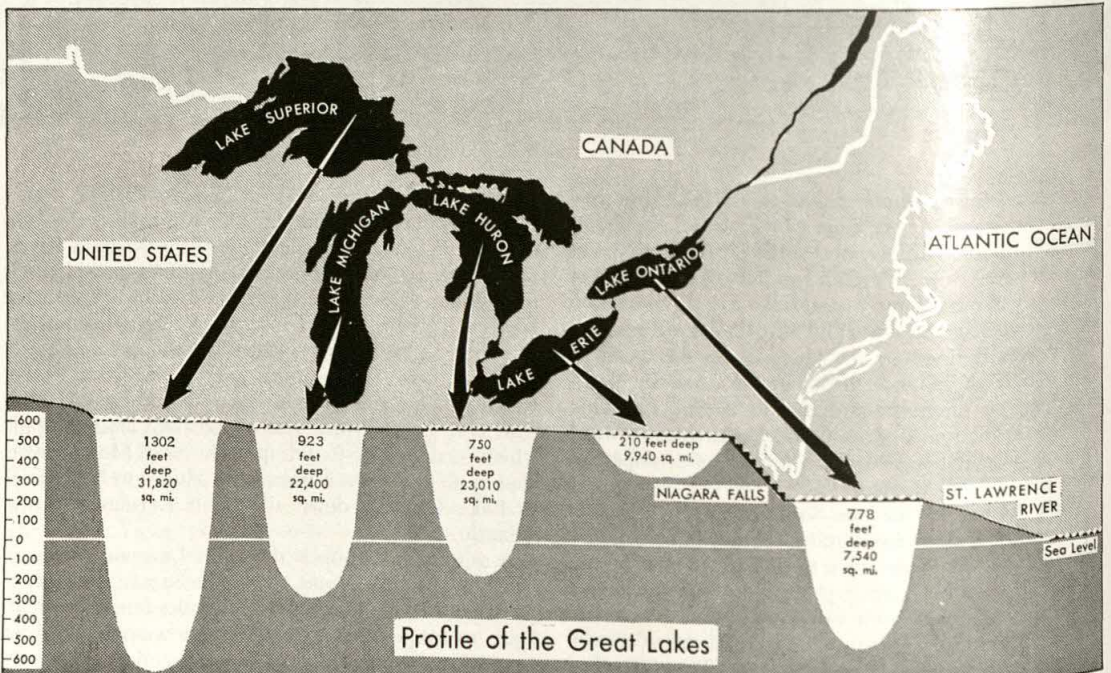
JOHN H. GARLAND

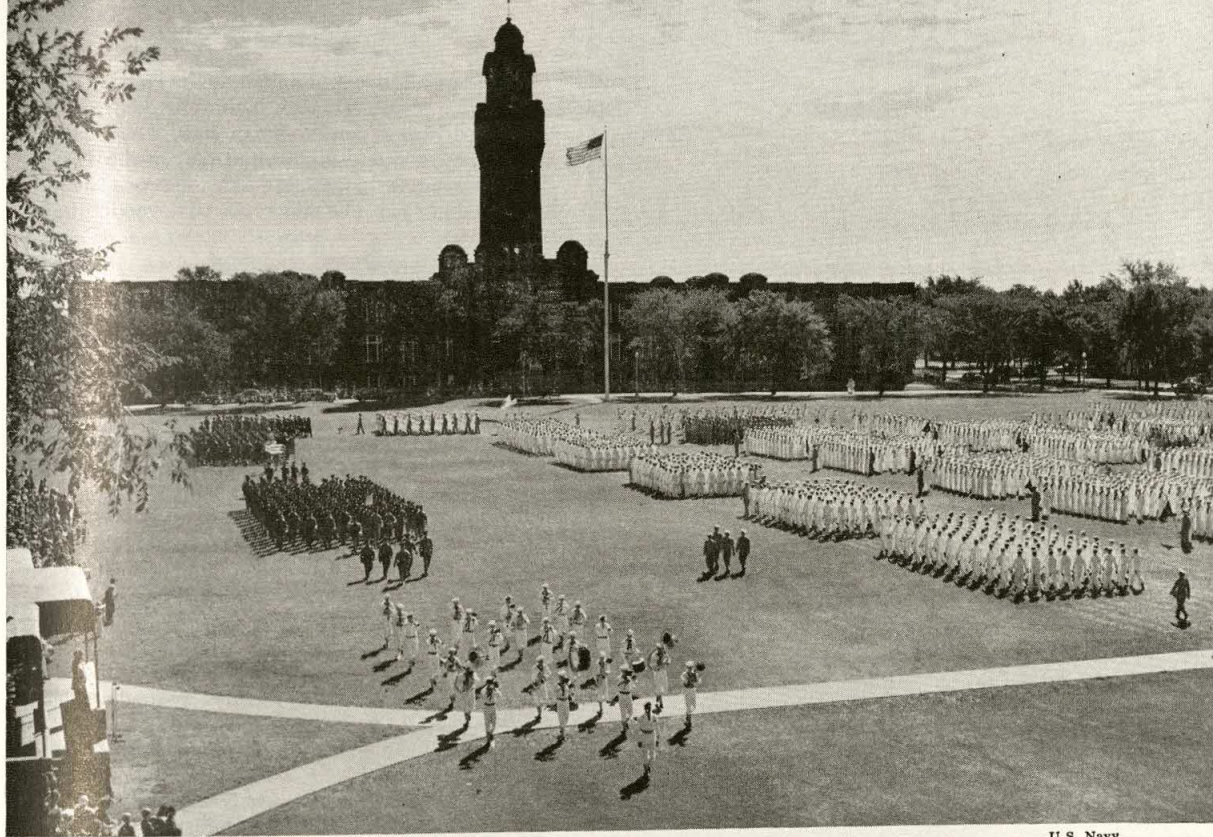
Related Articles in WORLD BOOK include:

Chicago (Harbor and River Traffic)	Lake Michigan
Chicago Sanitary and Ship Canal	Lake Ontario
Cleveland	Lake Superior
Detroit	Lakes-to-Gulf Waterway
Detroit River	New York State Barge Canal
Duluth	Niagara Falls and Niagara River
Erie Canal	Saint Lawrence River
Ice Age	Saint Lawrence Seaway
Icebreaker	Soo Canals
Lake Erie	Taft, Lorado (picture)
Lake Huron	Welland Ship Canal

GREAT LAKES NAVAL TRAINING CENTER, Ill., is the site of the United States Navy's largest recruit training command. It occupies 1,563 acres along Lake Michigan, 40 miles north of Chicago. The center serves as headquarters of the Ninth Naval District, the largest naval district in the United States. It also houses the Naval Examining Center that processes rating examinations for the entire navy, a Naval Hospital, a Naval Supply Depot, and an Electronics Supply Office. The recruit training command provides basic naval training and advanced training in various technical schools. Leading Chicago merchants bought the land in 1904, and presented it to the government. The navy commissioned the center in 1911. It trained 125,000 sailors at the center in World War I, and more than 1,000,000 during World War II.

JOHN H. THOMPSON





U.S. Navy

Naval Trainees March on the Parade Ground at Ross Field, Great Lakes Naval Training Center, for a Review.

GREAT LAKES-SAINT LAWRENCE SEAWAY. See SAINT LAWRENCE SEAWAY.

GREAT LAUREL. See RHODODENDRON.

GREAT MOGULS, KINGDOM OF THE. See MONGOL EMPIRE (Breakup); INDIA (The Mogul Empire).

GREAT NORTH ROAD. See FLAMINIAN WAY.

GREAT PACIFICATOR. See CLAY, HENRY.

GREAT PLAINS extend for 2,500 miles from northern Canada to southern Texas, and from the Rocky Mountains eastward for about 400 miles. The Great Plains form a dry highland that slopes to the Central Lowland at a rate of 10 feet a mile. The western boundary along the mountain front varies from 4,500 to 6,500 feet in height. The eastern boundary ranges from 1,500 to 2,000 feet in elevation. In Canada, the Great Plains are generally considered to include parts of Alberta and Saskatchewan. In the United States, they include eastern Montana, Wyoming, Colorado, New Mexico; and western North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas.

JOHN H. GARLAND

See also WESTERN FRONTIER LIFE (Building the Frontier).

GREAT PYRAMID. See PYRAMIDS.

GREAT PYRENEES is a large dog, which comes from the Pyrenees Mountains, where it works as a sheep dog. The Great Pyrenees stands between 27 and 32 inches high at the shoulders and weighs 90 to 125 pounds. It is slightly smaller than the Saint Bernard. It has a thick, white coat. The dog has a heavy head and rolling walk, like that of the Saint Bernard. See also DOG (color picture, Working Dogs).

HENRY P. DAVIS

GREAT SALT LAKE, an inland sea in northwestern Utah, is one of the natural wonders of the world. Scientists believe it was once part of a fresh-water lake which lay in that region ages ago and was larger than Lake Huron. This ancient lake, called Lake Bonneville by geologists, gradually dried up into several smaller lakes. The largest is Great Salt Lake. See UTAH (color map).

The area of the lake is greatly affected by the amount of rainfall and the amount of water which is withdrawn from tributary rivers for irrigation. In winter, when evaporation of the water is slowest, the lake usually increases greatly in size. On the average, Great Salt Lake covers about 1,500 square miles, and is about 75 miles long and 50 miles wide.

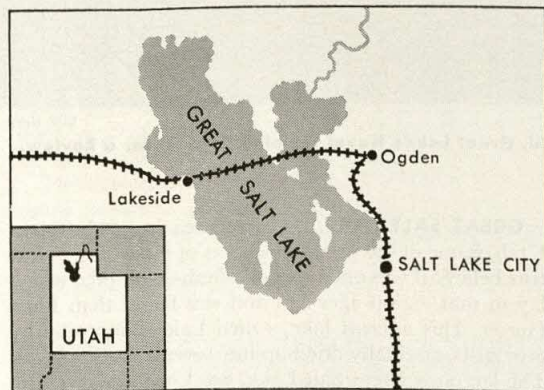
Great Salt Lake is fed by fresh-water streams. Yet it is from four to seven times as salty as the ocean. This is because the waters of the Great Salt Lake do not drain away, but dry up, leaving the salt deposit behind. About 200,000 tons of common salt are taken from the lake every year. The lake waters contain three parts of salt to every part of other minerals. Some Glauber's salt, a chemical used in medicines and in industry, is also taken (see GLAUBER'S SALT).

The shores of the several islands in the lake are white with salt. These islands are breeding grounds for large flocks of gulls, ducks, geese, and pelicans. The largest is Antelope Island, where farmers grow alfalfa and raise cattle. There is also a herd of wild buffalo on Antelope Island. There are no fish in Great Salt Lake, but the waters do contain a small brine shrimp. A tiny fly also lives in the water during its grub stage.



Fairchild Aerial Surveys, Inc.

The Shores of Several Islands in Great Salt Lake are whitened with salt, above. Trains cross the central part of the lake, below. The map inset shows the lake's location in Utah.



Mounds of Salt result when water is pumped from the Great Salt Lake and evaporates in the sun. The salt then goes to refineries.

Utah Tourist and Publicity Council



A pleasure resort, called Saltair, has been built on the southeastern shore. Tourists bathe there in the salt water, in which a person cannot sink. The Southern Pacific railway crosses the central part of the lake on the Lucin Cutoff. It uses a 13-mile-long rock-fill dike, completed in 1959. The dike replaced a wooden trestle built in 1904.

A. R. MORTENSEN

See also GREAT BASIN.

GREAT SALT LAKE DESERT is a low, flat, arid region in northwestern Utah, just west of Salt Lake City. It extends south for about 110 miles from the Grouse Creek Mountains, and borders on Nevada. The desert covers about 4,000 square miles. For location, see UTAH (color map). The Bonneville Speedway, also called the Bonneville Salt Flats, occupies about 100 square miles of extremely level salt beds near Wendover, close to the Nevada border. The salt there is as hard as cement, and racing drivers have set a number of international speed records on the Bonneville Speedway. World speed records for automobiles were established on it by Sir Malcolm Campbell (1935), Captain George E. T. Eyston (1938), and John Cobb (1947). For many years, the desert acted as a barrier to westward travel.

GREAT SAND DUNES NATIONAL MONUMENT is in southern Colorado, about 38 miles by road northeast of Alamosa. The national monument, established by Congress in 1932, covers an area of 36,740.32 acres, or about 56 square miles. Its sand dunes, deposited over thousands of years by southwesterly winds rising against the lofty Sangre de Cristo Mountains, are among the largest and highest dunes in the United States. Some of the dunes are more than 1,500 feet high.

GREAT SCHISM. See CHRISTIANITY (Heresies and Schisms); POPE (The Troubles of the Papacy); SIGISMUND.

GREAT SEAL OF THE UNITED STATES, also called SEAL OF THE UNITED STATES, symbolizes the sovereignty of the United States. The government adopted it on June 20, 1782. It uses the seal to authenticate important documents. European countries had long used seals, and the new nation signified its equal rank by adopting its own seal.

William Barton, a specialist in heraldry, advised the committee designing the seal. He designed most of the reverse side. Charles Thomson, secretary of the Congress, prepared the design for the face of the seal.

The Face bears the design used on official documents. The American eagle, with an *escutcheon*, or shield, on its breast, symbolizes America's self-reliance. Its pose is rather stiff because it is *displayed* in heraldic style. The 13 vertical stripes on the escutcheon came from the flag of 1777, but seven are white, while in the 1777 flag seven are red. The blue *chief* above the stripes in 1782 symbolized congress. But since 1789, it has meant all branches of the United States government. The eagle holds an olive branch of 13 leaves and 13 olives in its right talon, and 13 arrows in its left. It prefers to live in peace, but can wage war. In its beak is a scroll inscribed *E pluribus unum*, or *One (nation) out of many (states)*. Above its head is the 13-star "new constellation" of the 1777 flag, enclosed in a *glory*, or golden radiance, breaking through a cloud. See UNITED STATES, GOVERNMENT OF (color picture).

The Reverse Side of the seal may be seen on the back of the one-dollar bill, but it has never been used as a seal. A pyramid of 13 courses of stone, representing the

Union, is watched over by the Eye of Providence, enclosed in its traditional triangle. The upper motto, *Annuit coeptis*, means *He (God) has favored our undertakings*. The lower motto, *Novus ordo seclorum*, means *the new order of the ages* that began in 1776, the date on the base of the pyramid.

The present official drawing of the seal was made in 1885, when a fourth die was cut. The fifth die, which replaced it in 1904, is still in use. This die is on permanent exhibition in the Department of State Building in Washington, D.C., and may be seen in action by appointment.

DONALD H. MUGRIDGE

See also **E PLURIBUS UNUM**.



Great Slave Lake Lies in Northern Canada.

GREAT SLAVE LAKE, one of the largest lakes in the Americas, covers 11,170 square miles in Canada's Northwest Territories. It lies about 250 miles east of the Rocky Mountains. For location, see **NORTHWEST TERRITORIES** (map). The lake is fed chiefly by the Slave River, which combines the waters of the Peace and Athabasca systems. Its outlet forms the beginning of the great Mackenzie River.

A highway connects the south shore with a railroad in Alberta. Eight small settlements lie around the lake. Commercial fishing has become important since World War II. The market value of the annual catch exceeds \$2,000,000. Good timber on the south provides another source of income in the area. On the same side, a mining and smelting company has developed a large deposit of lead-zinc ore.

Great Slave Lake was named after the Slave tribe of Indians who lived in the area.

ALFRED LEROY BURT

GREAT SMOKY MOUNTAINS are so named because they are usually covered by a smoky mist or haze. They are among the highest and most rugged mountains in the Appalachian system.

The Great Smokies form the boundary between Tennessee and North Carolina. For location, see **TENNESSEE** (color map). The highest peak is Clingmans Dome (6,642 feet). Other peaks that are about or somewhat over 6,000 feet high include Mount Collins, Mount Le



Tennessee Conservation Department

Charles Bunion Peak in the Great Smokies is one of the many strange, treeless mountaintops in this national park.

Conte, Mount Kephart, Mount Chapman, Tricorner Knob, Mount Guyot, and Cam's Knob. The mountain slopes are covered with hardwood and evergreen forests which supply valuable timber.

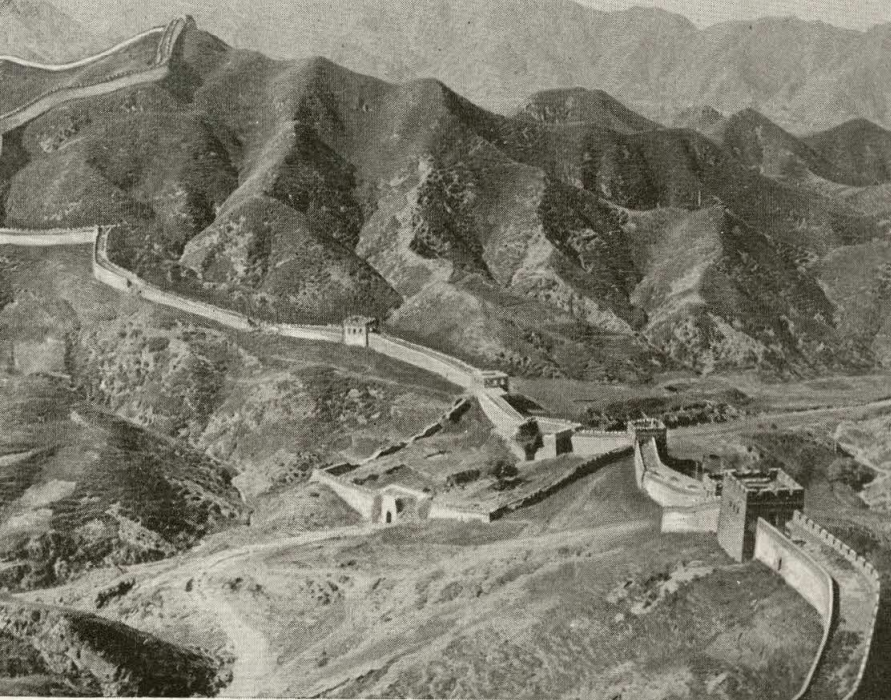
Minerals found in this area include clay, and a little gold and copper. Agriculture is limited to a few small mountain valleys and basins. In 1930, most of this mountain area was set aside by the federal government as a national park.

E. WILLARD MILLER

See also **BLUE RIDGE MOUNTAINS**; **CLINGMANS DOME**; **GREAT SMOKY MOUNTAINS NATIONAL PARK**.

GREAT SMOKY MOUNTAINS NATIONAL PARK contains the most extensive virgin hardwood and red spruce forests in the United States. It lies on either side of the boundary between North Carolina and Tennessee, with about half its area in each state. The park has an area of 511,677.98 acres. For location, see **TENNESSEE** (color map).

Most of the Great Smoky Mountains lie in the park. Sixteen peaks in the park are more than 6,000 feet high. The highest peak is Clingmans Dome, which rises to 6,642 feet in southeastern Tennessee. See **GREAT SMOKY**



Brown Bros.

The Great Wall of China was built to keep out the invading Tartars. The wall is considered a remarkable engineering feat. It follows a winding course over mountains and valleys, and is as long as from New York City to Omaha, or from the city of Quebec to Winnipeg, Canada. The wall is built of brick or dressed granite shell, filled with earth, and covered with a very hard coating of bricks in lime. At a point near Kalgan, it has been cut to admit the railway from Peking.



MOUNTAINS; CLINGMANS DOME.

There are about 150 kinds of trees in the park. Spruce, fir, and hemlock cover the highest mountains and slopes. Many kinds of shrubs and flowering plants grow in the park area. These include several varieties of delicate orchids. There are about 600 miles of clear, spring-fed streams which often end in roaring falls. These streams are full of trout. The famous Appalachian Trail winds through the park for more than 70 miles.

Cherokee Indians were the region's first settlers. Today, a number of mountaineers live in the area around the park. The National Park Service maintains several pioneer homes in the park.

In 1926, Congress passed a bill to create the Great Smoky Mountains National Park. The scenic park area was donated to the United States in 1930 by North Carolina and Tennessee. Federal financial aid, supplemented by a large gift from John D. Rockefeller, Jr., also helped establish the park.

HERBERT E. KAHLER

GREAT STAR FLAG. See FLAG (Changes in the United States Flag).

GREAT STONE FACE. See WHITE MOUNTAINS.

GREAT TREK. See SOUTH AFRICA (History).

GREAT VALLEY. See CALIFORNIA (Land Regions).

GREAT VICTORIA DESERT, an area of shifting sand dunes, stretches for about 800 miles across southwestern Australia. The desert covers an area of about 250,000 square miles. Because it merges on the north into the Gibson Desert, its area is not sharply defined. The desert lies north of the Nullarbor Plain. At some points the Great Victoria Desert spreads southward, to an area about 20 miles from the southern coast of Australia. Several small salt lakes lie in the center of this area. For location, see AUSTRALIA (color map). C. M. H. CLARK

GREAT WALL OF CHINA is the longest fortified line ever built. It stretches for more than 1,500 miles, winding through northern China from Lin-yu on the eastern coast to Kansu province in north-central China. Among

the Chinese, it is often described as the *Wall of Ten Thousand Li*. The *li* is a Chinese measurement, and is equal to one third of a mile.

The wall stands about 25 feet high. Towers from 35 to 40 feet high were built into the wall every 200 to 300 yards. The wall tapers from a width of 25 feet at the base to about 15 feet at the top. Its sides are made of earth, brick, and stone. The top is paved with bricks set in lime, forming a roadway for horsemen.

The Great Wall was built entirely by hand and took hundreds of years to complete. The first Ch'in emperor is credited with joining shorter walls to form the Great Wall. Archaeological investigations in recent years reveal that walls were built before the Ch'in period (221 to 207 B.C.). In the deserts of remote Sinkiang, Sir Aurel Stein found traces of a wall that was built later during the Han period (206 B.C. to A.D. 221). Such walls were one of the main defenses against nomad attack.

Under the short-lived but powerful Sui dynasty (A.D. 589 to 618), the Great Wall was expanded. More work was done on it during the Ming dynasty, from 1368 to 1644, but later rulers neglected it. The communist government in China has rebuilt parts of the Great Wall.

H. F. SCHURMANN

See also CHINA (History; color map).

GREAT WHITE FLEET. See NAVY, U.S. (History).

GREAT YARMOUTH, *Yahr muth* (pop. 51,500; alt. 25 ft.), is the center of the herring-fishing industry on the east coast of England. It produces cured herrings called *Yarmouth bloaters*. The city is about 122 miles northeast of London (see GREAT BRITAIN [color map]). It is famous for the *Rows*, a district of more than 140 narrow parallel lanes. Some of the lanes are only 3 to 5 feet wide. Great Yarmouth has an old church that is said to be the largest parish church in England. The town is the setting for part of Charles Dickens' *David Copperfield*.

FRANCIS H. HERRICK

GREAVE. See ARMOR.

GREAVES, CAPTAIN, or RED LEGS, was a Scotch-Irish pirate in the 1670's. He became a pirate when he accidentally climbed aboard a pirate ship to escape a cruel master. He killed the pirate captain in a duel, and was elected captain. He was a successful pirate, but he never robbed the poor or mistreated prisoners. He retired after capturing an island off the Venezuelan coast. He was imprisoned for piracy in 1680, but an earthquake destroyed the prison. He won a pardon, and was loved and respected when he died. WILLARD H. BONNER

GREBE, *greb*, is any of a group of diving birds. Grebes dive under water to get fish to eat. There are about 20 kinds of grebes, and they live throughout the world. About six kinds live in North America.

Grebes are strange-looking birds with strange habits. They have long, flattened bodies, thickly covered with waterproof feathers. They do not have webbed feet like most diving birds. But each toe has a separate flaplike membrane. Their wings and tails are short. Their legs are far back on their bodies, and their feet are long. This makes the birds clumsy and almost helpless on land. But grebes dive and swim with such ease that they have been called *hell-divers* and *water witches*. Grebes do not like to fly, and have great difficulty getting off the ground. But once they are in the air, they can fly long distances.

Grebes make nests of decaying plants and water-soaked grasses. They build the nests in the shallow water of lakes or ponds, usually in rushes. The nests float like rafts on the rising and falling water. The young can swim as soon as they hatch. When they grow tired, they rest in air pockets formed on the undersides of their mother's wings. Scientists believe that grebes are the only birds that carry their young under the water surface. Many grebes were once killed for their feathers, which were used to decorate women's hats. The birds are now protected by law.

The North American species of grebes include the large *western*, or *swan*; the *red-necked*, or *Holboell's*; the *pied-billed*, or *dabchick*; the *horned*; and the *eared*.

Scientific Classification. Grebes make up the family *Podicipedidae*. The western grebe is genus *Aechmophorus*, species *occidentalis*. Holboell's is *Podiceps grisegena*. The



El Greco painted *Portrait of a Man*, above, using a dark background for contrast. *Agony in the Garden*, right, is one of his famous religious paintings.



The Art Institute of Chicago

GRECO, JOSÉ

horned is *P. auritus*, the eared *P. nigricollis*. The pied-billed is *Podilymbus podiceps*. ALFRED M. BAILEY

See also **BIRD** (color pictures, Water Birds, Bird Nests).

GRECO, *GRAT koh*, **EL** (1541?-1614), was one of the greatest painters in the history of art. Although born on the island of Crete, he did most of his work in Spain. His paintings reflected the mysticism and religious emotionalism of that country better than the works of any native-born Spaniard.

In his elongated and twisted figures, the undulating lines of his designs, and his use of color, El Greco revealed an inspiration and a disdain of material truth that can be found elsewhere only in the works of contemporary painters. For this reason, he is considered one of the forerunners of contemporary art. In his great masterpiece, *Burial of Count Orgaz*, he achieved an understanding of how to express in material form the relationship between the natural and the supernatural.

El Greco painted several outstanding religious works. His paintings, *Christ Carrying the Cross* and *Pietà*, appear in color in the **JESUS CHRIST** article. In his portraits, he often distorted anatomy, but always revealed the personality of the sitter. His *View of Toledo* is considered the greatest landscape painting in the history of art. It appears in color in the **PAINTING** article.

El Greco was born DOMENIKOS THEOTOKOPOULOS on the island of Crete. While young, he went to Venice and studied under the painter Titian. The Italian painters Correggio and Michelangelo also influenced him. He later made his way to Spain and, at the age of 36, settled in Toledo. EDWARD S. SHORTER

See also **RESURRECTION** (picture); **VIRGIN MARY** (picture).

GRECO, *GRECK oh*, **JOSÉ** (1918-), became one of the world's best Spanish dancers. He learned Spanish dancing in New York City. In 1942, the dancer Argentinita saw Greco in a night club and asked him to join her act. He soon became her partner. He later danced with her sister, Pilar López, in Madrid. Greco formed his own company in 1949. He was born in Italy and grew up in Brooklyn, N.Y. LILLIAN MOORE



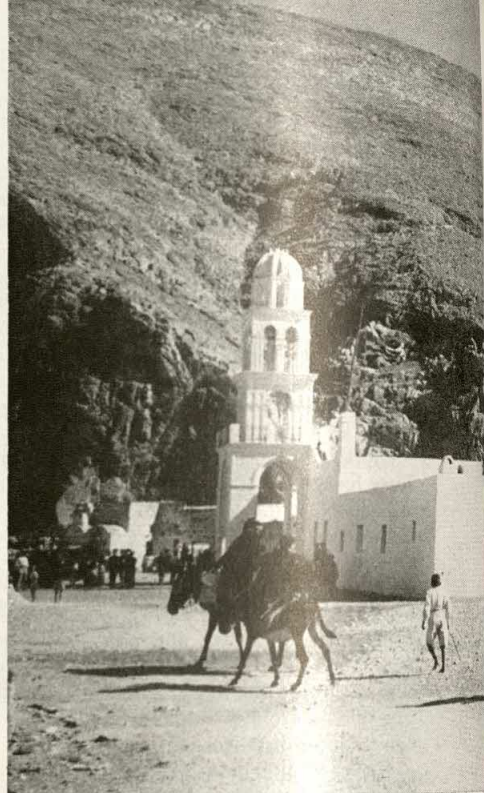
Gendreau

GREECE

ΕΛΛΑΣ

Ruins of Temples may be found throughout Greece as reminders of the country's great history. The Parthenon, left, is a famous example of Doric architecture.

A Whitewashed Monastery stands on rocky Thira, one of the many small islands of Greece. Farm families arrive on mules for early morning services.



GREECE is a mountainous kingdom in southeastern Europe. It was once the center of a powerful and far-flung civilization. But modern Greece is a little smaller than Alabama, and has fewer people than live in Texas. Greeks call their country *VASILION TIS ELLADOS*, which means *KINGDOM OF HELLAS*. *Hellas* is an ancient name for Greece, and the Greeks call themselves *Hellenes*. Athens is the capital and largest city.

More than half the people make their living by farming. Gray-green olive trees and grape vineyards grow on the mountain slopes that cover four fifths of the country. Greece is a seafaring nation and more than 300 Greek merchant ships carry goods throughout the world.

The blue waters of the Mediterranean Sea border Greece on three sides. Many gulfs, bays, and inlets help form one of the longest coast lines of any European country. Hundreds of rocky islands make up about one fifth of the area of the country. The largest Greek island, Crete, was the seat of the ancient seagoing Aegean civilization.

Greece is one of the Western democracies, and is a member of the United Nations and the North Atlantic Treaty Organization. For the relationship of modern Greece to other European countries, see *EUROPE*; *NORTH ATLANTIC TREATY ORGANIZATION*.

The culture, art, and traditions of ancient Greece

provided the basis for Western civilization. For a description of life in ancient Greece, see the separate article on *GREECE, ANCIENT*.

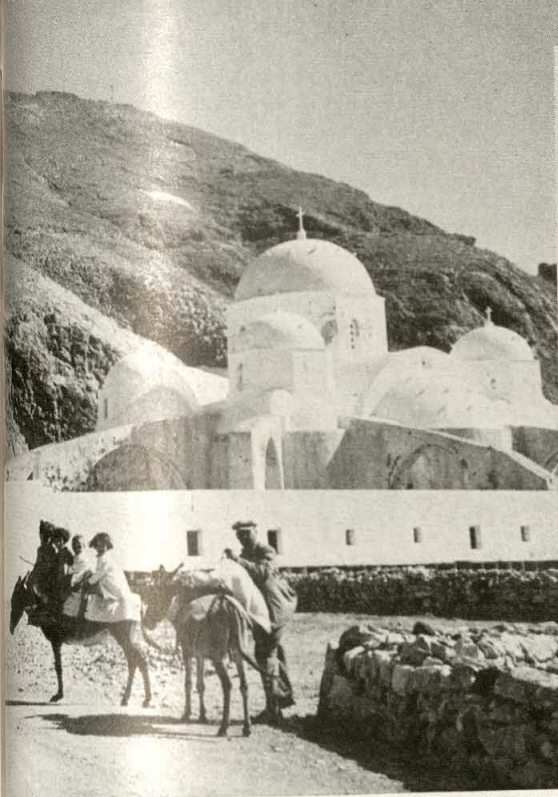
The Land and Its Resources

Location and Size. Most of Greece lies in the southern part of the Balkan Peninsula. Southern Greece covers the *Peloponnesus*, a peninsula connected with the Greek mainland by the Isthmus of Corinth. Several hundred Greek islands form steppingstones across the Aegean Sea to Turkey. The communist countries of Albania, Yugoslavia, and Bulgaria lie along the northern boundary of Greece. The eastern tip of northern Greece borders Turkey. The Aegean Sea, the Sea of Crete, and the Ionian Sea, all arms of the Mediterranean Sea, rim the rest of Greece. The *Color Map* with this article shows that bodies of water lie on three sides of the country. Greece covers 51,182 square miles.

Land Regions. Greece may be divided into four land regions. They are: (1) northern Greece, (2) central Greece, (3) southern Greece, and (4) the islands.

Northern Greece. The northeastern part of Greece is mostly a series of low-lying coastal plains. It includes the ancient regions of Macedonia, Thessaly, and Epirus. The three-pronged Khalkidhiki Peninsula juts southeastward into the Aegean Sea in this region. Mount Athos, a self-governing community of 20 Eastern Orthodox monasteries, stands at the tip of the easternmost prong. No women or female animals have ever been allowed to enter this community.

The rest of northern Greece has high mountain ranges that stretch from north to south and enclose fertile valleys. Some of the mountains rise steeply from the seashore. The Pindus Mountains extend the entire



David Seymour, Magnum; Pix



Evzones of the Greek Royal Guard act as the honor guard at the royal palace and the Tomb of the Unknown Soldier in Athens. Their unusual uniforms lend color to parades.

length of northern Greece. Many mountains in this range are famous in legend and history. Mount Olympus, near the northeastern coast, was the fabled home of the ancient Greek gods. According to Greek legend, Apollo, the god of light, often visited Mount Parnassus on the Gulf of Corinth.

Central Greece is the southeastern corner of the mainland. It has many plains, separated from each other by mountains or by the sea. Athens and other ancient city-states developed on these plains (see **CITY-STATE**).

FACTS IN BRIEF

Form of Government: Constitutional monarchy.

Capital: Athens.

Official Language: Greek.

Divisions: 51 *nomoi*, or departments.

Head of State: King.

Parliament: 300 members, elected by popular vote for four-year terms.

Area: 51,182 sq. mi. *Greatest distance*, mainland, (north-south) 331 miles; (east-west) 283 miles. *Coast line*, mainland, about 2,500 miles; islands, about 6,350 miles.

Elevation: *Highest*, Mount Olympus, 9,550 feet above sea level; *Lowest*, sea level.

Population: 7,631,124. *Density*, 149 persons per sq. mi. *Distribution*, rural, 62 per cent; urban, 38 per cent.

Chief Products: *Agricultural*, currants, figs, grapes, olives, raisins, tobacco, goats, sheep. *Manufactured and Processed*, cheese, cigarettes, olive oil, wine. *Mineral*, bauxite, lead, marble, silver.

Flag: The flag has five blue and four white horizontal stripes, with a white cross in a blue canton. See **FLAG** (color picture, Flags of Europe).

National Anthem: "Imnos pros tin Eleftherian" ("The Hymn to Liberty").

National Holiday: Independence Day, March 25.

Money: *Basic unit*, Drachma. For its value in dollars, see **MONEY** (table, Values). See also **DRACHMA**.

Southern Greece consists of the mountainous Peloponnesus. The western part has coastal plains and lowlands. Twice as many people live here as in the barren, stony eastern part of southern Greece.

Islands make up about one fifth of the territory of Greece. There are more than 200 islands in the *Cyclades*, a series of islands extending into the Aegean Sea east of the Peloponnesus. The *Dodecanese*, or *Sporades*, form another group of Aegean islands. These 12 islands lie much closer to Turkey than to Greece. Historic Rhodes is in the Dodecanese. *Crete*, which lies about 60 miles southeast of the Peloponnesus, is the largest island of Greece. Crete covers a little more than 3,000 square miles. *Euboea*, the second largest island, lies just east of central Greece. The *Ionian Islands* lie off the western coast. At one point, the Strait of Otranto on the west separates Greece from Italy by less than 50 miles.

Coast Line. The coast line of the Greek mainland and the Peloponnesus looks somewhat like the coast of New England. Many gulfs and bays cut far into the land. The deep gulfs of Corinth and Aegina almost separate the Peloponnesus from the mainland. The Greek islands have a total coast line of about 6,350 miles. The mainland of Greece has about 2,500 miles of coast line.

Rivers and Lakes. The rivers of Greece become rushing mountain torrents in the spring. Most of them cannot be used as a source of water for irrigation in summer because they dry up. Boats cannot sail on the rivers because part of the time the currents flow too swiftly, and the rest of the time there is no water. The chief rivers are the Akhelos in central Greece and the Alpheus in the Peloponnesus. The Aliakmon is the chief river in northern Greece. Surface water often sinks

GREECE



Greece Lies at the Tip of the Balkan Peninsula.

through holes in the limestone beneath the soil.

The lakes of Greece are neither large nor important. The main ones include lakes Voiveis and Trikhonis.

Natural Resources. Greece has large deposits of lignite, a low-grade coal, and small deposits of many other minerals. The most important ones include lead, silver, bauxite, nickel, chromite, iron, copper, and tin. The country has a great deal of white and colored marble. Greece has no petroleum deposits.

The thin soil is not good for farming, and must be cultivated carefully. Marsh areas have been drained to increase the amount of farm land, but only about one fifth of the country can be cultivated.

Climate. Winters are long and bitter in the mountains, where the temperature averages about 15° to 30°F. The climate is milder on the plains near the sea, where winter temperatures seldom drop below 40° to 50°F. In general, summers are hot. The average summer temperature in Athens, for instance, is 81°F. There is little rain except in winter, when four inches a month usually falls. Summer air is clear and dry.

Life of the People

The People. Greece has a population of 7,631,124. There are about 150 persons to the square mile. This is about three times as many as in the United States. Almost two thirds of the people live in farm areas, and a little more than one third live in city areas. The modern Greeks have assimilated many foreign elements, but are more Greek than anything else. Turks and Slavs make up about 2 per cent of the country's population.

Language. Many English words come from the Greek language, and all the alphabets of European countries are based on the Greek alphabet. For a history of the language, see GREEK LANGUAGE.

Family Life. Greek families are close-knit. The father is the central authority. He earns the money, makes the major decisions, and takes part in local activities. The mother stays close to the home, managing it and raising the children.

Shelter. Most Greek homes have thick stone walls. These walls help keep the homes warm during the winter, and cool during the summer. The walls are usually whitewashed. Houses in farm areas average three to four rooms in size. They usually have one

story, with a sleeping loft, and only a few pieces of furniture. The kitchen serves as the center of family life. City homes are larger and better furnished. Many city people live in apartments.

Food. Favorite food dishes include fish, lamb, olives, and fruit. The people use much olive oil for cooking. Typical Greek dishes include *souvlakia* (lamb cooked on a skewer), *moussaka* (eggplant stuffed with ground lamb), and *soupa avgolemono* (lemon-flavored chicken soup).

Clothing. Most of the people wear clothing similar to that worn in North America. On feast days, they sometimes dress in elaborate, colorful costumes. The men may wear long woolen tights and heavily braided jackets. The women appear in long, brightly colored skirts and full-sleeved white blouses. They wear strings



The United States Is 70 Times Larger than Greece.

of gold bangles around their necks. See also CLOTHING (color picture, Europe).

Recreation. Water sports such as fishing, swimming, and boating are especially popular. Many Greeks also enjoy hunting, mountain climbing, and hiking.

A popular form of entertainment in Greece is the *Karagiozis*, or shadow play. It is performed with a screen. The "actors" are cardboard figures that are moved about with long sticks. Lamps or candles behind the cardboard actors throw their shadows on the screen. The hero of every performance is *Karagiozis*, a hunch-backed dwarf. He is a clever troublemaker who invents stories to obtain food for his family.

City Life. Greece has more than 20 cities with over 20,000 people, and also a number of smaller cities. The largest cities are Athens, Salonika, and Piraeus. All the cities lie on or near water, and most of them started as city-states. Few of the buildings are more than four or five stories high.

Life in cities such as Athens and Salonika is much like that in the United States and Canada. The other cities offer fewer employment opportunities. See the separate articles on Greek cities listed in the *Related Articles* at the end of this article.

Country Life. The hardy Greek farmers live under difficult conditions. The rugged countryside has poor soil. The farmers lead simple lives and eat plain food. Most farms are small, averaging about five acres. The average farm has a small house and several buildings for livestock. It also has a vegetable garden, in addition



GREECE

Evergreen Trees
Deciduous Trees
Shrub

National Capitals
Cities
Railroads

1 inch = 75 Statute Miles
Miles 0 10 20 40 60
Conic Projection

GREECE (Map Index)

Regions

AEGEAN ISLANDS

(NÉSOI)
AIYAIÓNS)* C 5
Pop. 528,766

CENTRAL GREECE AND

EUBOEA (STEREÁ)
ELLÁS KAI
ÉVVOIA)* B 4
Pop. 2,284,805

CRETE (KRÍTÍ)

Pop. 462,124
EPÍRUS (ÍPIROS) B 3
Pop. 330,543

IONIAN ISLANDS

(ÍONIÓI NÉSOI) B 2
Pop. 228,597

MACEDONIA

(MAKEDHONÍA) A 3
Pop. 1,700,835

PELOPONNESOS

(PELOPONNESUS) C 3
Pop. 1,130,505

THESSALY

(THESSALÍA) B 3
Pop. 628,195

THRACE (THRÁKI)

Pop. 336,754

Political Divisions

(Nomes)

Names not shown on map.
Index key shows general location.

AITOLIA KAI

AKARNANÍA (AETOLIA
AND ACARNANIA) B 3
Pop. 220,138

AKHAIA (ACHAEA)

Pop. 230,467
ARGOLIS C 4
Pop. 85,389

ARKADHÍA

(ARCADIA) C 4
Pop. 154,361

ÁRTA

Pop. 72,717
ATTIKÍ (ATTICA) B 4
Pop. 1,553,815

ÁYION ÓROS

(MOUNT ATHOS) A 5
Pop. 3,086

BOEOTIA, see VOIOTÍA

DHODHEKÁNISOS

(DODECANESE) C 6
Pop. 121,480

DRÁMA

Pop. 120,492
EVKITANIA (EURYTANIA) B 3
Pop. 39,678

ÉVROS (HEVROS)

Pop. 141,340
ÉVVOIA (EUBOEA) B 4
Pop. 164,542

FLÓRINA

(PHLORINA) A 3
Pop. 69,391

FOKIS (PHOCIS)

B 4
Pop. 51,472

FTHIOTIS

(PHTHIOTIS) B 4
Pop. 148,322

ILÍA (ELIS)

C 3
Pop. 188,274

IMATHÍA

(HEMATHEIA) A 4
Pop. 96,439

IOÁNNINA

B 3
Pop. 153,748

IRÁKLION

(HERAKLEION) D 5
Pop. 189,637

KARDHÍTSA

B 3
Pop. 138,736

KASTORÍA

A 3
Pop. 46,407

KAVÁLLA

A 5
Pop. 136,337

KEFALLINÍA

(CEPHALONIA) B 3
Pop. 47,369

KÉRKIRA (CORFU)

B 2
Pop. 105,414

CHALCIDICE

A 4
Pop. 75,735

KHANIÁ (CANEIA)

D 4
Pop. 126,524

KHÍOS (CHIOS)

B 6
Pop. 66,823

KIKLÁDHES

(CYCLADES) C 5
Pop. 125,959

KILKIS

A 4
Pop. 89,475

KORINTHÍA

(CORINTHIA) C 4
Pop. 113,358

KOZÁNI

A 3
Pop. 177,838

LAKONÍA (LACONIA)

C 4
Pop. 130,785

LÁRISA (LARISSA)

B 4
Pop. 208,120

LÁSITHI

D 5
Pop. 73,784

LESVOS (LESBOS)

B 6
Pop. 154,795

LEVKÁS (LEUCAS)

B 3
Pop. 37,752

MAGNISÍA

(MAGNESIA) B 4
Pop. 153,808

MESSINÍA

(MESSENIA) C 4
Pop. 227,871

MOUNT ATHOS, see

ÁYION ÓROS

PELLÁ A 4
Pop. 116,969

PIERÍA

A 4
Pop. 86,161

PRÉVEZA

B 3
Pop. 56,779

RETHÍMNI

(RETHYMNE) D 5
Pop. 72,179

RODHÓPI (RHODOPE)

A 5
Pop. 105,523

SÁMOS

C 6
Pop. 59,709

SÉRRAI

A 4
Pop. 222,549

THESPROTÍA

B 3
Pop. 47,299

THESSALONÍKI

(SALONIKA) A 4
Pop. 459,956

TRIKKALA

B 3
Pop. 127,481

VOIOTÍA (BOEOTIA)

B 4
Pop. 106,838

XÁNTHI

A 5
Pop. 89,891

ZÁKINTHOS (ZANTE)

C 5
Pop. 38,062

Cities

Agrínio, 20,048 B 3
Aitolikón, 5,959 B 3
Aiyina, 5,525 C 4
Aiyion, 15,070 B 3

Alexandropólis, 16,632 A 5
Alistráti, 4,951 A 4
Almíros, 7,034 B 4

Amaliás, 15,189 C 3
Ámfissa, 5,553 B 4
Ándros, 2,236 C 5

Áno Theológos, 2,320 A 5
Áno Viánnos, 1,961 D 5
Anóyia, 3,072 D 5

Apránnthos, 2,438 C 5
Areópólis, 1,217 C 4
Argalastí, 3,021 B 4

Árgos, 13,163 C 4
Árgos Orestikón, 4,292 A 3
Argostólion, 8,724 B 3

Árnis, 2,915 A 3
Árta, 12,947 B 3
Astakós, 2,992 B 3

Atalándi, 4,277 B 4
Athens (Athínai), 565,084 (*1,378,586) B 4
Ayiá, 8,286 B 4

Ayiá Paraskeví, 4,357 B 6
Ayiassos, 5,692 B 6
Áyios Nikólaos, 3,321 D 5

Dhidhimotíkhon, 8,136 A 6
Dhimítsina, 1,710 C 4
Dráma, 29,498 A 5

Édhessa, 14,935 A 4
Ekhnios, 4,005 A 5
Elásson, 5,755 B 4

Eressós, 3,301 B 5
Erithrai, 3,495 B 4
Fársala, 5,768 B 4

Filiatrá, 9,209 C 3
Flórina, 12,270 A 3
Galaxidhion, 2,240 B 4

Gargaliánoi, 7,658 C 3
Grevená, 5,191 A 3
Ídhra, 2,843 C 4

Ierápetra, 5,516 D 5
Ierissós, 2,768 A 4
Igoumenítsa, 2,448 B 3

Ioánnina, 32,315 B 3
Iraklión (Candia), 51,144 D 5
Istiaia, 5,364 B 4

Itea, 2,532 B 4
Itháki, 2,760 B 3
Kalámai, 37,781 C 4

Kalávrita, 2,208 B 6
Kálimnos, 9,683 C 4
Kardhítsa, 18,543 B 3

Kariaí, 453 A 5
Káristos, 3,118 B 5
Karlóvasi, 5,024 C 6

Karpénision, 3,700 B 3
Kastélii, 2,205 D 4
Kastória, 9,468 A 3

Kástron, 3,497 B 5
Kateríni, 24,605 A 4
Katokhí, 1,750 B 3

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Kavállá, 42,102 A 5
Kéa, 2,201 C 5

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Khóra Sfakion, 382 D 5
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Kilkis, 9,702 A 4
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Leonidhion, 3,356 C 4
Levádhia, 10,915 B 4

Levkás, 6,541 B 3
Limni, 3,398 B 4
Litókhoron, 5,032 A 4

Loutrá Aidhipsoú, 5,028 B 4
Mándra, 3,594 B 4
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Palamás, 5,370 B 4
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Pílos, 3,314 C 3
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Siáftista, 4,980 A 3
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Vólos, 51,144 B 4
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Xánthi, 25,700 A 5

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Yithion, 7,112 C 4
Zagorá, 3,223 B 4

Zákynthos, 11,126 C 3
Zevgolatió, 1,089 C 3
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Aiyina (Aegina) (Isl.) C 4
Akheólös R. B 3
Akritís (Isl.) C 6

Aliákmon R. A 3
Alfiós R. C 3
Amorgós (Isl.) C 5

Anáfi (Isl.) C 5
Andikithira (Isl.) D 4
Ándros (Isl.) C 5

Arakthos R. B 3
Astipálaia (Isl.) C 6
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Cape Dhrepanon B 5
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Cape Matapan C 4
Cape Sidheros D 6
Cape Spáthia D 4

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Crete (Isl.) D 5
Crete, Sea of C 5

Cyclades (Is.) C 5
Dhenodása (Isl.) C 5
Dhílos (Isl.) C 5

Dia (Isl.) D 5
Dodecanese, see Sporades
Erimnthos (Mtn.) C 3

Évros R. A 6
Evrotás R. C 5
Evstratios (Isl.) B 5

Évvoia (Isl.) B 4
Fanós (Isl.) B 2
Gulf of Amvrakia B 3

Gulf of Argolis C 4
Gulf of Corinth B 4
Gulf of Kassandra A 4

Gulf of Kavállá A 5
Gulf of Khania D 4
Gulf of Kiparissia C 3

Gulf of Laconia C 4
Gulf of Merabéllio D 5
Gulf of Messini C 3

Gulf of Pátrai B 3
Gulf of Salonika A 4
Gulf of Strimón B 4

Gulf of Vólos B 4
Ídhra (Hydra) (Isl.) C 4
Ikaría (Isl.) C 6

Iliodhromía (Isl.) B 4
Ionian Is. B 2
Ionian Sea B 2

Íos (Isl.) C 5
Itháki (Isl.) B 3
Kajmakálan (Mtn.) A 3

Kálimnos (Isl.) C 6
Kárpáthos (Isl.) D 6
Kásoos (Isl.) D 6

Kéa (Isl.) C 5
Kefallinia (Cephalonia) (Isl.) B 3
Kérkira (Corfu) (Isl.) B 2

Khalki (Isl.) C 6
Khalkidhiki Peninsula A 4
Khios (Chios) (Isl.) B 5

Kithira (Cythera) (Isl.) C 4
Kithnos (Isl.) C 5
Kós (Isl.) C 6

Lake Vistonis A 5
Lake Voivis B 4
Lake Volvi A 4

Lésvos (Isl.) B 5
Lévíthos (Isl.) C 6
Levkás (Leucas) (Isl.) B 3

to its cultivated fields, vineyards, or orchards.

Buildings in the many small villages are usually small and neat. The mountain sides on which the villages stand are often so steep that the houses seem to be built on top of each other. Most villages have a square where the people meet and talk.

Work of the People

About 60 of every 100 persons work in agriculture, about 17 in trade, and about 9 in manufacturing. The rest of the people make their living in occupations such as fishing and lumbering.

Agriculture is the chief industry. More farms lie in the mountains of western Greece than on the plains of the east because more rain falls in the mountains.

Olive trees, fruit trees, and vineyards grow on most of the cultivated land. The dusty, gray-green olive trees play an important part in Greek life. Olive oil replaces butter, because the country has few cattle. Greece exports large quantities of olives and olive oil.

The currant is perhaps the most distinctive Greek crop. Farmers dry currants to make black Corinthian raisins. The currant grows best around the city of Corinth, for which it was named. Other fruits of Greece include figs, lemons, and oranges. Fine cigarette tobacco comes from Macedonia and Thrace, and cotton grows in many parts of the country. Farmers also raise wheat and other grains, but large quantities of grain must be imported to meet the country's needs.

Greek shepherds tend their flocks of sheep and goats in much the same way their ancestors did hundreds of years ago. They make cheese from the milk of goats and sheep, and weave cloth from their wool.

Manufacturing and Processing. Except for cotton, Greece neither grows nor produces the raw materials that could make it a manufacturing country. The Athens-Piraeus area has most of the country's industry. Factories make olive oil from the best olives, and wine from grapes. Other products include cloth, thread, chemicals, cigarettes, and refined petroleum.

Power. Only about one third of the homes in Greece have electricity. Steam engines generate about 97 per cent of the country's power, and hydroelectric plants generate the rest. The Greeks use only about 3 per cent of their potential water power to generate electricity. Lack of money has limited the development of hydroelectric projects. The largest projects include installations on the Ladon River in the Peloponnesus and the Louros River in northern Greece.

Trade. Greece imports much food and clothing, as well as many manufactured products. In exchange, Greece exports agricultural products, including olives, olive oil, currants, figs, tobacco, and cheese. Greece trades mostly with West Germany, Great Britain, the United States, Italy, and The Netherlands. The value of Greece's imports is usually larger than the value of its exports.

Transportation. Few places in Greece lie more than 40 miles from the sea. Travel from place to place is often easier and faster by water than by land because of the many mountains. The people use *caïques*, or small rowboats, for this kind of travel. A fleet of small ships provides transportation between the islands. Greece has a merchant marine of more than 300 ships.

The Greeks built a canal across the Isthmus of

Corinth in 1893 to shorten the route between the Aegean and Ionian seas. But the canal is only about 69 feet wide, which is too narrow for large ships.

Few roads and railroads have been built, because of the mountainous land. The country has about 13,800 miles of roads and about 1,675 miles of railroads. A Greek airline travels routes over the mountains, over the water from island to island, and to other countries. Airlines of other countries also connect Athens with principal cities throughout the world.

Communication. Telegraph and telephone service links the main Greek cities. Radio stations provide news and entertainment. More than 1,000 community radios serve isolated villages. Most of them are in town halls, town squares, or local coffee shops. Athens, the publishing center, has more than 20 newspaper plants and several book- and magazine-publishing houses.

Activities of the People

Education. Greek law requires all boys and girls between the ages of 6 and 14 to go to school. However, this law is not always enforced in country districts. More than one fourth of the people cannot read or write.

Greeks have always honored learning, and many wealthy Greeks have founded private or public schools. The country has about 1,000 kindergartens and 10,000 elementary, 500 secondary, and 40 commercial schools. Athens has two universities, and Salonika has one.

Religion. Almost all the people belong to the Greek Orthodox faith, the state religion. Persons of other faiths have freedom of worship. About 135,000 Moslems, 30,000 Roman Catholics, 7,000 Protestants, and 2,000 Jews live in Greece. See EASTERN ORTHODOX CHURCHES.

Religious festivals play an important part in Greek life. Almost every village has a patron saint. On the evening before the saint's day, everyone goes to church. After the religious service, the people enjoy food and wine, and sing and dance far into the night.

The Arts. Many Greeks are skilled weavers of rugs and articles of clothing. Embroidery is another important handicraft. Silversmiths hammer silver into heavy necklaces. Prominent literary figures include the poet Kostas Palamas (1859-1943), the prose writer Alexander Papadiamantis (1851-1911), and the novelist and poet Nikos Kazantzakis (1883-1957). Dimitri Mitropoulos (1896-1960) gained fame as a conductor of symphony orchestras.

For descriptions of the arts of ancient Greece, see GREECE, ANCIENT.

What to See and Do in Greece

The ruins of ancient Greece are the chief attraction for most travelers. The most famous ruins are on the Acropolis in Athens. Here stand the Erechtheum and the temple of Nike Apteros. The Acropolis also includes the Parthenon, which many people consider the world's most beautiful building. Another famous Greek ruin is the shrine of the oracle of Apollo at Delphi. The National Archaeological Museum in Athens is the country's best-known museum.

The indented coast line and the many attractive

GREECE

islands provide fine beaches, yachting harbors, and places to fish.

Government

Greece is a constitutional monarchy similar to Great Britain. The head of the state is the king, but the monarch does not rule. The Greek constitution, adopted in 1952, gives most of the country's political power to the *premier*, who heads the cabinet (see **CABINET**). The Greek Parliament has only one house, unlike the British Parliament, which has two houses. The highest Greek court is the Supreme Court of Appeals.

The King is a hereditary ruler. However, he has little power, and serves chiefly as a symbol of the unity of the Greek nation. The king appoints the premier for an indefinite term. The premier must have the support of Parliament in order to remain in office.

Parliament. The 300 members of the Greek Parliament are elected by popular vote. In 1958, Parliament approved a new electoral vote system, based on proportional representation.

Courts. In addition to the Supreme Court of Appeals

in Athens, Greece has 10 Courts of Appeal, 55 lower courts called Courts of the First Instance, and several special courts. The king, on the recommendation of the minister of justice, appoints the judges for life terms. As in the United States, Greek law is based on the constitution, statutes passed by the legislature, and previous court decisions (see **LAW** [Sources of Law]).

Local Government. Greece is divided into 51 *nomoi*, or departments. An official called a *nomarch* heads each of the *nomoi*. The minister of the interior appoints these officials for indefinite terms.

Politics. All persons over the age of 21 who can read and write may vote in national elections. The leading political parties are the National Radical Union, the Liberal Democratic Union, the Liberal, and the Democratic Union of the Left.

Armed Forces. All eligible Greek men over the age of 21 must serve in the armed forces. Draftees serve two years on active duty, followed by 29 years in the reserve. A military mission from the United States has trained Greek armed forces since 1948.

Soldiers called *Evzones* act as the honor guard at the royal palace and the Tomb of the Unknown Soldier in Athens. The dashing Evzone dress uniform consists of a billowy white thigh-length skirt called a *fustanella*, and a matching shirt with long full sleeves. An embroidered vest is worn over the shirt. A bright red sash wrapped around the waist has a dagger stuck in it. Long white leggings, upturned shoes with blue tassels on the ends, and a red cap with a long blue tassel complete the colorful uniform. The uniform of the Evzones was first worn by Greek mountain fighters who found it convenient for climbing.

RED-LETTER DATES IN GREECE

- 1453 Greece became part of the Ottoman (Turkish) Empire.
- 1822 Greece declared its independence.
- 1829 Greece defeated Turkey in the Greek War of Independence.
- 1830 Greece became a kingdom.
- 1912-1913 Greece fought in the two Balkan Wars.
- 1917-1918 Greece fought on the Allied side in World War I.
- 1919-1923 Turkey defeated Greece in a fight for control of Smyrna.
- 1924 Greece proclaimed itself a republic.
- 1935 The country voted to become a kingdom again.
- 1941-1944 Germany, Italy, and Bulgaria occupied Greece during World War II.
- 1947-1949 Civil war between communists and nationalists raged in Greece.
- 1956 First use of a nationwide electric-power system.
- 1958 Parliament approved an electoral reform law.

History

The recorded history of ancient Greece dates back to about 3000 B.C. For the history of the country until A.D. 1453, see **GREECE, ANCIENT**; **ROMAN EMPIRE**; and **BYZANTINE EMPIRE**.

Turkish Rule. The Byzantine Empire, of which Greece was the heart, broke up in 1453 under attacks by the Ottoman Turks. In that year, the Turks conquered Constantinople (Istanbul) and created an empire of their own. See **TURKEY** (History).

The Turks allowed the Greeks to keep their self-government through their church. Leaders of the church controlled most local educational, religious, and



David Seymour, Magnum

Outdoor Cafés in Village Streets offer Greeks the chance to visit with friends, one of their favorite pastimes.

governmental affairs. Many Greeks settled throughout the Mediterranean, and in England and southern Russia. Greek ships sailed the Mediterranean trade routes, and Greek merchants gained influence.

Greek War of Independence. The Greeks rose against the Turks on March 25, 1821, and declared their independence in January, 1822. For the next eight years, the Greeks fought against repeated Turkish military efforts to regain control of the country.

In 1827, Greece received the military support of Great Britain, France, and Russia. Their navies defeated the Turkish fleet at the battle of Navarino off the Peloponnese on October 20, 1827.

The Greek War of Independence aroused the sympathy of many Europeans. The British poet, Lord Byron, was an especially strong supporter of the Greek revolt. Byron regarded the Greeks of his day as the heirs of ancient Greek glory.

The Kingdom of Greece. Greece achieved complete independence through the London Protocol of 1830. By the terms of this agreement, Great Britain, France, and Russia recognized the independence of Greece. Later in 1830, Turkey accepted the terms of the London Protocol. The first king of Greece was Otto I, a Bavarian prince who came to the throne in 1832. He was chosen by Great Britain, Russia, and France. Otto was never popular, and a military revolt forced him to give up the throne in 1862.

The Greek national assembly selected Prince George of Denmark as ruler, and he became King George I of Greece in 1863. In 1864, Great Britain gave Greece the Ionian Islands. These islands had been part of the British Empire, but most of their people were Greeks. In 1881, Greece obtained Thessaly from Turkey as a result of the Congress of Berlin (see BERLIN, CONGRESS OF).

In 1897, Greece tried to seize the island of Crete, where members of the Greek Orthodox Church had revolted against the Turks. The Turks defeated the Greeks, and only the help of Russia, Great Britain, Austria-Hungary, and Germany saved Greece from complete ruin.

The Balkan Wars. In 1912, Greece, Serbia, Bulgaria, and Montenegro formed an alliance against Turkey to achieve their nationalistic aims. These countries defeated Turkey in two wars in 1912 and 1913. Greece won a large part of Macedonia and many Aegean islands, including Crete. But the wars left the country with little manpower or money. See BALKANS.

King George I was assassinated at Salonika in March, 1913, and his son, Constantine I, became king.

World War I. When World War I broke out in 1914, Greece hastily declared its complete neutrality. The country was in an embarrassing position. Queen Sophia was a sister of Emperor Wilhelm II of Germany, and King Constantine and the rest of the Greek royal family were pro-German. But most of the Greek people favored Great Britain and France.

Greek liberals, led by the statesman Eleutherios Venizelos, overthrew King Constantine in 1917 and made his son, Alexander, king of Greece. The King appointed Venizelos premier. Guided by Venizelos, Greece entered World War I on the side of the Allies in 1917, and fought Turkey and Bulgaria.

After World War I, the peace settlement awarded the Turkish city of Smyrna (Izmir) to Greece. The city had



David Seymour, Magnum

Motor Ships provide transportation between the country's many islands. Passengers go to and from the ships in rowboats. In stormy weather, the islands may be cut off for days.

The Karagiozis, a shadow play of puppets on sticks, is a popular form of entertainment in Greece.



Pix

Modern Greek Dancers carry antique water bottles gracefully on their heads.



(1882-1953). The king's oldest son followed his father as King George II, but he was exiled by Premier Venizelos in 1923.

The Greek Republic. Greece proclaimed itself a republic on May 1, 1924, and the country entered a period of political upheaval. Personal ambitions for power sharpened the dispute between royalists, who wanted a return to monarchy, and republicans, who believed in the new republic. Premier Venizelos established friendship with Turkey in 1930. He also promoted closer relations with the other Balkan countries, because these countries felt they would all be stronger through closer association.

Downfall of the Republic. The elections of 1933 brought the Greek monarchists back into power. In 1935, troops crushed a republican revolt led by Venizelos. The republicans refused to vote in the general elections held in the fall of 1935, because they suspected that the royalists controlled the voting. About 1,500,000 persons voted for the return of the monarchy, and only 32,000 supported the republic. George II returned from exile on November 25, 1935.

The parliamentary elections of 1936 resulted in a deadlock between the republicans and the royalists. King George named as premier General Ioannes Metaxas. With the consent of King George, Metaxas established a dictatorship on August 4, 1936. The king felt he needed Metaxas' support in order to stay on the throne. In 1938, the king appointed Metaxas premier for life.

World War II. Greece declared its neutrality when World War II began in 1939. But on October 28, 1940, Premier Benito Mussolini of Italy sent Metaxas an ultimatum demanding the use of Greek bases. Metaxas rejected Italy's ultimatum, and Mussolini sent troops into Greece. The Greeks had few fighting men and poor equipment, but they had a good military leader, Alexander Papagos (1883-1955). They forced the Italian Army to retreat into Albania, and even captured about one fourth of Albania by December, 1940.

The Greeks might have won their war with Italy if the German Army had not come to the aid of Italy. Germany invaded Greece on April 6, 1941, and was followed immediately by the Bulgarian Army. A British force of about 60,000 men helped the Greeks, but the German forces quickly overran the country. German, Italian, and Bulgarian troops occupied Greece. The Germans established a puppet government in Athens.

The Greeks suffered terrible hardships, including

been a Greek colony hundreds of years before the birth of Christ. Many Greek-speaking Christians had settled in Smyrna, and Greek patriots dreamed of uniting the ancient colony with the modern Greek kingdom. With Allied support, Greek troops captured Smyrna in May, 1919.

War broke out between Greece and Turkey over Smyrna. King Alexander died in 1920, and King Constantine returned from exile to continue the fight against Turkey. In September, 1922, the Turks, led by Mustafa Kemal Atatürk, retook Smyrna. The Treaty of Lausanne, signed in July, 1923, forced the Greeks to give up all their claims to land in Turkey. Greece also agreed to the transfer of about 1,500,000 persons of the Greek Orthodox faith from Turkey to Greece. A similar number of Turks were transferred from Greece to Turkey.

The Greeks blamed King Constantine for the loss of the war with Turkey. He was forced to abdicate in 1922, under pressure from General Nicholas Plastiras

starvation, during the occupation. But bands of Greek soldiers kept up continuous opposition through guerrilla fighting.

After World War II. Late in 1944, Greek and British forces drove the Axis Powers out of Greece. But peace and order came slowly to the war-torn country. Instead of a single national army, Greece had a number of guerrilla bands fighting among themselves. Some, for instance, were royalists, while others were communists. A communist-led group called the EAM (National Liberation Front) and its military arm, the ELAS (Hellenic Popular Liberation Army), hindered attempts to unify the country and begin reconstruction. The EAM closely resembled communist-front organizations in Yugoslavia, Albania, and Bulgaria that eventually set up communist dictatorships in those countries. The EAM received its orders from Russia.

The communists in Greece began a civil war against the Greek government in the mid-1940's. A United Nations commission investigated and reported that the communist governments of Albania, Bulgaria, and Yugoslavia were sending arms and men to help the Greek communists. In 1948, the communist government of Yugoslavia broke with Russia and ended its help to the Greek communists. The Greek army, under Alexander Papagos, defeated the rebels in 1949.

On September 1, 1946, the Greek people voted for the return of King George. He ruled until his death on April 1, 1947. George's brother then came to the throne as King Paul I.

Great Britain gave economic and military aid to Greece following World War II. But in 1947 the economic crisis in Great Britain forced the British to withdraw their help. President Truman of the United States announced the Truman Doctrine to send economic aid to countries endangered by communists. The United States Congress authorized \$400,000,000 for aid to Greece and Turkey. Other United States grants and loans to Greece followed, and technical experts were sent to help rebuild the country. Among other accomplishments, this aid helped rebuild railroads, bridges, and factories, and improved communications and power installations.

The 1950's. Papagos formed the Greek Rally party in 1951. Its purpose was to stabilize the political system. The party won the 1952 election, and Papagos became premier. Also in 1952, Greece joined the North Atlantic Treaty Organization (NATO). Women voted and became candidates for parliament for the first time in Greek history in the local elections of January, 1953. In February, the country signed a treaty of friendship and collaboration with Turkey and Yugoslavia. In 1954, the same countries formed a military alliance.

Cyprus was a British colony off the coast of Turkey, but four fifths of its people are of Greek descent. In 1954, the Cypriotes demanded union with Greece. The British offered self-government, but not union. This led to riots and fighting on Cyprus, which continued through the 1950's. Agreements in 1959 resulted in independence for Cyprus in 1960 (see **CYPRUS**).

Constantine Karamanlis became premier in 1955 after the death of Papagos. Greece began using its first nationwide electric-power system in 1956. Built at a cost of \$115,000,000, the system links together cities and villages throughout the mainland. Karamanlis

resigned as premier early in 1958, after governmental conflict over his proposed electoral reform plan. King Paul appointed Constantine Georgakopoulos premier of Greece. In March, 1958, Parliament approved Karamanlis' electoral plan, based on proportional representation. Karamanlis returned as premier of Greece after his National Radical Union won the general elections in May, 1958. In 1961, Greece worked out a 5-year plan for economic redevelopment. It then became associated with the European Common Market. **HARRY N. HOWARD**

Related Articles. For separate articles about ancient Greece, see the list of Related Articles at the end of **GREECE, ANCIENT**.

BIOGRAPHIES

An alphabetical list of biographies relating to modern Greece appears under the heading **Greece** in the **BIOGRAPHY** section of the **READING AND STUDY GUIDE**.

CITIES

Athens	Piraeus	Salonika
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PHYSICAL FEATURES

Aegina	Euboea	Pelion
Attica	Ionian Islands	Peloponnesus
Corfu	Macedonia	Rhodes
Corinth Canal	Melos	Salamis
Crete	Messenia	Samos
Cyclades	Olympia	Samothrace
Dodecanese	Olympus	Thessaly
Islands	Parnassus	Thrace
Epirus	Paros	

UNCLASSIFIED

Aluminum (table)	Europe, Council of	Ship and
American School of	European Monetary	Shipping
Classical Studies	Agreement	(table)
Balkans	Greece, Ancient	Tobacco
Drachma	Lemon	World War I
Easter (In Greece	Olive	World War II
and Romania)	Olive Oil	

Outline

- | | |
|--|----------------------|
| I. The Land and Its Resources | |
| A. Location and Size | D. Rivers and Lakes |
| B. Land Regions | E. Natural Resources |
| C. Coast Line | F. Climate |
| II. Life of the People | |
| A. The People | D. City Life |
| B. Language | E. Country Life |
| C. Family Life | |
| III. Work of the People | |
| A. Agriculture | D. Trade |
| B. Manufacturing and Processing | E. Transportation |
| C. Power | F. Communication |
| IV. Activities of the People | |
| A. Education | B. Religion |
| | C. The Arts |
| V. What to See and Do in Greece | |
| VI. Government | |
| VII. History | |

Questions

- What has held back economic progress in Greece?
- What do the Greeks use in place of butter? Why?
- How does Greece compare in size with your state or province? In population?
- What are some of the tourist attractions in Greece?
- Why is water transportation important in Greece?
- What is the country's best-known crop?
- What vital resource does Greece lack?
- What is Mount Athos? Souvlakia? A caïque?
- How long have women been allowed to vote in Greece?



PELLA

STAGIRA

Alexander the Great, born at Pella, carried Greek culture to Egypt, Asia Minor, and Persia.

Mount Olympus

Zeus and Hera, King and Queen of the Greek gods, supposedly held court on Mount Olympus.

Aristotle, the philosopher, was born at Stagira. After studying with Plato in Athens, he returned to Macedonia to teach young Alexander.

LEGEND AND HISTORY

Thermopylae

Mount Parnassus

The Oracle of Delphi answered questions about the future. A priest interpreted messages that the Greeks believed were sent by Apollo.

DELPHI

CHALCIS

THEBES

Marathon

ELEUSIS

ATHENS

CORINTH

MYCENAE

ARGOS

TIRYNS

Salamis

SPARTA

AEGEAN SEA

IONIAN SEA

The Olympic Games began at Olympia. Popular sports included wrestling, track, boxing, and discus throwing.

In the Battle of Salamis, Athenian warships sank or destroyed half the Persian fleet. After this victory, Athens became a great naval power and ruler of the seas.

Delos

Naxos

Theseus, the mythical king of Athens, killed the man-eating Minotaur who lived in King Minos' labyrinth on the island of Crete.

KNOSSOS

Crete

Greek Warships had sharply pointed rams attached to their prows. The rams were used to smash and sink enemy ships.

MEDITERRANEAN SEA

ANCIENT GREECE

GREECE, ANCIENT. The people of ancient Greece were the first to develop a democratic way of life. More than 2,000 years ago, they originated the idea that every citizen should take an active part in the government. Historians regard the Greeks as the founders of Western civilization.

Greek civilization was far more advanced than any that had come before. The world's first great dramatists, historians, orators, philosophers, and poets were Greek. The ancient Greeks were the first people to study botany, geometry, medicine, physics, and zoology on a scientific basis. They held the first athletic games.

The ancient Greeks called themselves *Hellenes*, and their land *Hellas*. They never united to form a national government, but they were united by a common culture, religion, and language. They considered anyone whose native language was Greek a Hellene, even if he did not live in Greece. They called anyone who did not speak Greek a *barbarian*.

Greek civilization developed on a rocky, mountainous peninsula that juts into the Mediterranean Sea from southeastern Europe, and on the jagged islands in the nearby sea. Mountains made land travel difficult. The people of each plain and island formed an independent community called a *city-state*. No city-state had enough good land to support all its people. Communities quarreled bitterly with one another, instead of uniting under a national government. Athens and Sparta became the most famous city-states.

The Land and Its Resources

Location and Size. Ancient Greece included the Balkan Peninsula south of Macedonia and many islands in the Aegean and Ionian seas. The main part of ancient Greece covered an area of about 30,000 square miles. It was a little smaller than the state of Maine. The country included what are now the central and southern parts of modern Greece (see GREECE [colored map]).

In addition, the Greeks regarded all the colonies they founded overseas as Greek lands. These included

In the Trojan War, Ulysses fooled the Trojans. He sent them a huge wooden horse as a gift, with his soldiers hidden inside.

TROY

Lesbos

ASIA

Chios

MINOR

Samos

Icaria

MILETUS

The Parthenon in Athens was built in 447 B.C. in honor of Athena, the patron goddess of the city. Like other public buildings of its time, the beautiful Doric temple was built of marble and then brightly painted. It was severely damaged more than 2,000 years later, during a war between the Turks and Venetians.



Guiver, Shostal

The Ruins of Delphi stand in a wooded valley near Mount Parnassus. Thousands of Greeks came to Delphi to consult the oracle. The Greeks built a religious city of temples, treasure houses, and other buildings to honor the gods.

F. P. G.



GREECE, ANCIENT

many towns in Sicily and southern Italy, wealthy cities in what is now Turkey, and scattered trading posts around the Black Sea. Greek colonists made settlements as far away as India, Portugal, and Sudan.

Surface Features. Jagged limestone mountains rose on three of every four acres of ancient Greece. Forests covered the mountain slopes. The largest plains lay in Thessaly in the north, in Attica and Boeotia in central Greece, and in Laconia and Messenia in the Peloponnese, the southern peninsula of Greece. The peaks of submerged mountain chains stood in the sea as islands.

Natural Resources. The soil of Greece was more fertile in ancient times than it is today. But even then, only about one of every four acres could be cultivated. The rest of the land was rocky and unfit for growing crops. Farmers could use it only for pasture. Most farmers raised goats and sheep. A few had cows, hogs, and horses. The land contained so few natural resources that the Greeks had to depend on commerce and colonies for wealth.

The country's forests were larger in ancient times than they are today. Their trees helped hold water in the soil. Most of the ancient forests were cut down for use as fuel, because Greece has no coal.

The mountains of Greece provided much marble, but only small amounts of mineral ores. The Greeks mined some copper, gold, lead, and silver, but little iron. Gold came from the islands of Siphnos and Thasos. The regions of Laureion and Maronea supplied silver.

Boars, deer, and hares roamed the forests and provided Greek hunters with food and sport. The seas around Greece supplied fine catches of fish.

Climate. Ancient Greece usually had a mild, pleasant climate. About 25 inches of rain fell every year, most of it during the winter. The people lived almost entirely out of doors in summer. Even though winter winds were quite cold, the Greeks held most public assemblies and entertainments in the open air.

Life of the People

The People of ancient Greece had a mixed European ancestry. No more than 2,000,000 persons ever lived in the country, because there was not enough land to support more than that. As a result, many persons who were born in Greece moved to overseas colonies.

The classes in Greek society varied from one city-state to another. Athens had three classes: (1) citizens, who were the most numerous; (2) slaves; and (3) *metics*, or resident aliens. Sparta also had three classes: (1) citizens; (2) *helots*, or serfs, who were the most numerous; and (3) *perioeci*, or noncitizens.

The Greeks usually limited citizenship to persons whose fathers were citizens. Only citizens took part in the government, and only citizens could own land. Most slaves belonged to individual owners, but several city-states also used slaves in the state mines. A serf could own personal property, but he could not move from the place where he was born (see *SERF*). *Metics* and *perioeci* had no political rights, but they enjoyed personal freedom and were protected by law.

Language. The ancient Greeks spoke many different dialects for hundreds of years. After about 330 B.C., a common dialect called *koine* (pronounced *KOY nee*)

developed from the earlier dialect spoken in Athens.

Many invaders marched into ancient Greece. They usually adopted the Greek language and Greek ways, and soon it became hard to tell them from the people they had conquered. Socrates, who lived more than 2,000 years ago, could probably read one of today's Greek newspapers. But he would probably have difficulty, because of the many changes these peoples made in the Greek language. See *GREEK LANGUAGE*.

Family Life. "In Greece," wrote the historian Herodotus, "poverty is always a guest." The people led simple lives. Both farm and city folk began their day at dawn and ended it shortly after sunset.

Shelter. In the cities, the Greeks built their simple homes around open courtyards. On one side, the home had a roofed hall called a *pastas*. Smaller rooms opened onto the courtyard from the other sides. The Greeks built their homes of stone or sun-dried brick, covered with stucco. For heat in the winter, they burned charcoal in pans. Narrow alleys ran between the windowless houses. Greek farmers lived in small brick or stone houses. They usually built stone walls around their farmyards, which included sheds for the animals.

Food. Most Greeks ate only two meals a day. The midmorning meal, or *ariston*, often consisted only of a dish of beans or peas and a raw onion or a roasted turnip. About sunset, they ate *deipnon*, the main meal. It usually included bread, cheese, figs, olives, and sometimes a bit of fish or meat.

The Greeks had no sugar, but used honey to sweeten their food. They used olive oil instead of butter as a spread for bread. Olive oil also served as a cooking grease and as a soap. Most Greeks drank a mixture of wine and water. They considered milk fit only for animals and barbarians.

Clothing. The Greeks developed a graceful and beautiful costume. Both men and women wore a *chiton* (pronounced *KY tun*), a tunic that fell either to the knees or to the ankles. A narrow belt drew in the woman's chiton at the waist. Most chitons were made of wool. Only the richest Greeks could afford chitons of cotton or linen. The people wore brown chitons for work, and bleached white ones on formal occasions.

Both men and women also wore *himations* (pronounced *hih MAT ih ahns*), or cloaks, which they draped over their shoulders and arms. A young man sometimes wore a *chlamys* (pronounced *KLAY mis*), or short cape, fastened at the shoulder. A woman might wear a *peplos*, a variation of the chiton. Indoors, the Greeks usually went barefoot. Out of doors, many wore sandals. Most Greeks went bareheaded.

Recreation. Every city and town had an outdoor gymnasium where men could exercise or play various kinds of ball games. Children often rolled hoops or played with dolls. Older men sat in the *agora*, or marketplace, playing checkers or chatting. Greek women worked almost all the time, and enjoyed little recreation. Hunting was the favorite pastime in farm areas.

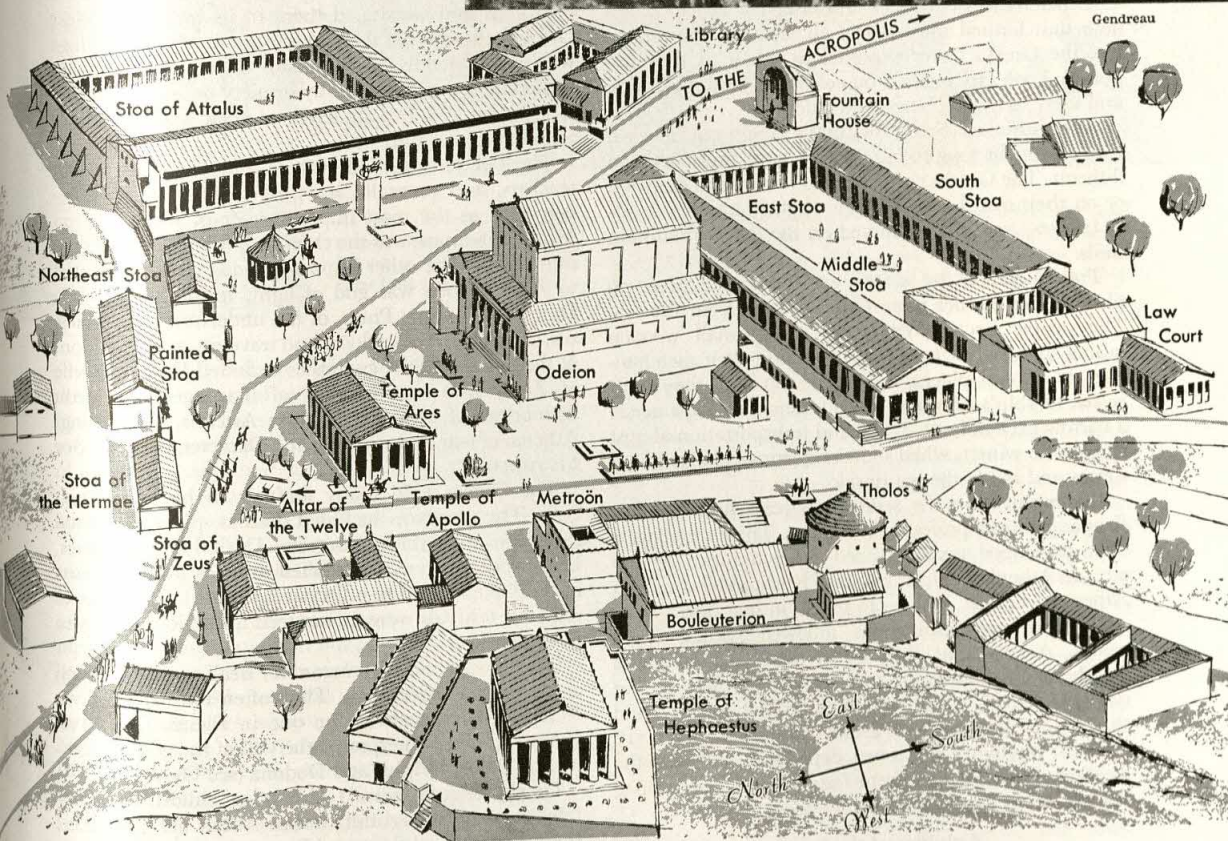
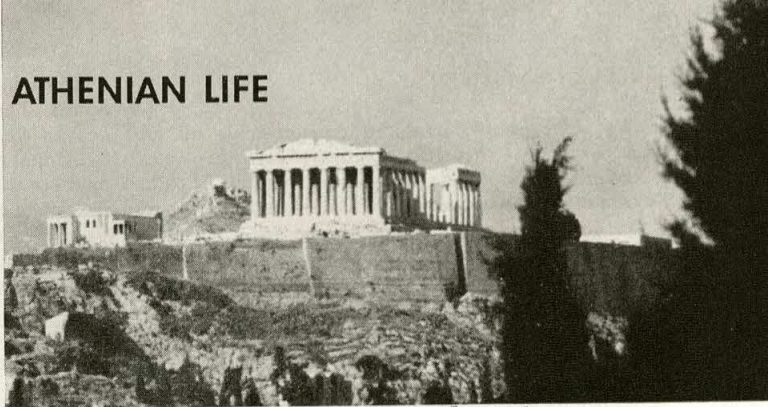
Work of the People

Agriculture. Farming was the chief occupation of the ancient Greeks. They harvested barley and wheat in spring, and picked grapes and olives in fall. They also grew apples, figs, and pomegranates. Many farmers raised sheep and goats. The Greeks used horses

THE CENTER OF ATHENIAN LIFE

The Acropolis, a fortified hill, stood above the center of Athens. The ancient Greeks built the Parthenon and other temples on the hill.

The Agora, or market place, was Athens' civic center. It lay at the foot of the Acropolis. As it appeared about A.D. 51, it included *stoas*, which had shops and meeting places; the *Odeion*, a theater; and government buildings such as the Bouleuterion, Metroön, and Tholos.



and cattle to carry loads and as work animals.

Serfs did the farm work on the plains of Laconia, Messenia, and Thessaly. But in other parts of Greece most farmers owned their land and cultivated it themselves. They carefully terraced the small farms that lay on the hillsides. Greek farmers did almost all their work by hand. They used digging tools called *mattocks* and ox-drawn plows made from the forked sections of trees. They cultivated only half their fields each year, and let the other half lie fallow so that the land would remain fertile. The Greeks never irrigated their soil, and seldom used fertilizer.

Manufacturing. Craftsmen made most of the manufactured goods in ancient Greece. Freemen and slaves often worked side by side, and received the same wages. The chief products included metal objects,

pottery and tiles, and woolen textiles. Greek pottery ranked as the best in the world. The most important cloth-producing cities included Athens and Megara. Miletus, Athens, Corinth, and Rhodes were pottery-making centers. The people of Thasos worked gold, and Athens won fame for its silver. Corinth produced bronze ware, and copper goods came from Chalcis.

Several cities had shipyards, and most of them had small factories that made armor, furniture, and kitchen utensils. Some cities became famous for one special product. Cyrene produced silphium, a plant used for medicine; Cythera made purple dye; and Tanagra made clay statuettes of people and animals. Lesbos and Athens produced the best olive oils.

Trade. The economy of ancient Greece depended almost entirely on three products: olives, grain, and

GREECE, ANCIENT

grapes. The people produced enough olive oil for their needs, but they had to import large quantities of grain. Most imported grain came from Egypt, Scythia (southern Russia), and Sicily. The Greeks exported silver, wine, and manufactured goods.

The principal Greek commercial cities included Aegina, Athens, Corinth, and Samos. After the 330's B.C., Delos and Rhodes also became important commercial centers. Greek merchants traded chiefly with the cities of the eastern Mediterranean and the Black Sea, and with settlements in Sicily and southern Italy. The merchants of Rhodes established a system of sea laws that formed the basis of all later maritime laws. But the Greeks never exported as much as they imported. Each city insisted on collecting customs duties, and used its own coinage and calendar.

Transportation. Steep mountain ranges cut off each valley from its neighbors, making land transportation difficult. The Greeks carried goods in carts, on donkeys, or on their own backs. But the country had few roads or bridges, and robbers lurked on the lonely mountain trails.

Transportation by water was easier, because no place in Greece lies more than 40 miles from the sea. The people became expert in using small wooden sailing ships called *holkades* to transport their merchandise. In several places, notably at Corinth, they built *holkoï*, or ship's railways, to pull merchant ships across a narrow neck of land. Trade and transportation almost stopped in winter, when snow and storms blocked land routes and made the sea unsafe.

Communication. To send messages within Greece, the people hired professional runners. These messengers often developed amazing speed and endurance. In 490 B.C., an Athenian runner named Pheidippides ran from Athens to Sparta, about 140 miles, in one day.

Overseas communications followed regular trade routes. A merchant ship under the most favorable weather conditions could travel about 60 miles during daylight. Greek warships, galleys called *triremes*, had three banks of oars as well as sails, and could travel 110 miles in daylight. But travel depended much on the weather. It might take from four days to a month to deliver letters from Athens to Rhodes.

Activities of the People

Education in Greece differed in several ways from education today. Girls received no formal education, but learned household duties and handicrafts from their mothers. The chief aim of Greek education was to prepare a boy to be a good citizen. As a result, education varied considerably from one city-state to another, according to various ideas of what made good citizens. The ancient Greeks had no technical education to prepare students for a business or trade.

In Sparta, education was almost entirely physical, and was organized along military lines. Boys lived in barracks from the age of 7 until they were about 30. Their education included endless gymnastic and athletic exercises. Teachers often whipped the boys, sometimes severely, to enforce discipline. The Spartans reached manhood in fine physical condition, but they were usually ignorant. Only a few could read and write.

Education in Athens contrasted sharply with that in Sparta. The Athenians believed their city-state would become strongest if every boy fully developed his best individual talents. The government did not control the pupils or the schools. An Athenian boy began school at the age of 6, watched over by a *paedagogos*, a trusted slave. He studied arithmetic, literature, music, physical education, and writing. He also memorized much poetry. He learned to take part in state and religious processions. The boys had holidays only on festival days. The government required all youths to take two years of military training when they became 18.

Religion. Each city-state in ancient Greece had its own gods and worshiped them in its own way. Most Greeks believed that their gods were superhuman beings who were friendly to mankind. They felt that men could anger the gods only by impiety or insolence. The Greeks did not live in terror of their gods, as other ancient peoples did.

The Greeks regarded Homer and Hesiod as great teachers, and generally accepted the gods these poets described as the most important. Zeus, who lived on Mount Olympus, was the chief god, ruling men and the other gods. The other important gods were all related to Zeus. Apollo was god of light, music, and youth; Dionysus, of wine; Pluto, of the underworld; Hephaestus, of fire; Hermes, of flocks and travelers; and Poseidon, of the sea. The chief goddesses included Hera, the wife of Zeus, who was goddess of marriage and birth; Aphrodite, of love and beauty; Artemis, of hunting; Athena, of war and wisdom; and Demeter, of crops. See MYTHOLOGY.

The Greeks held many festivals in honor of their gods. The programs included dramas, prayers, animal sacrifices, and athletic contests. The Olympic Games, held every four years, attracted athletes from all parts of the Greek world (see OLYMPIC GAMES). Travelers to religious festivals were guaranteed a safe journey, even in time of war.

The Greeks had high regard for healing shrines, such as the one at Epidaurus. They often formed religious secret societies, such as the one in Eleusis (see MYSTERIES). Oracles interpreted the will of the gods in temples at Delos, Delphi, and Dodona (see ORACLES).

Greek religion seemed almost as childish as fairy tales to many thoughtful Greeks. About the 330's B.C., the people turned first to philosophy and then to various Oriental religions for spiritual aid and comfort. Isis, an Egyptian goddess, and Mithras, a Persian god, attracted many followers. St. Paul brought Christianity to Greece about A.D. 51. But the ancient Greek religion did not die out until the Roman Emperor Justinian closed the Athenian schools of philosophy in A.D. 529.

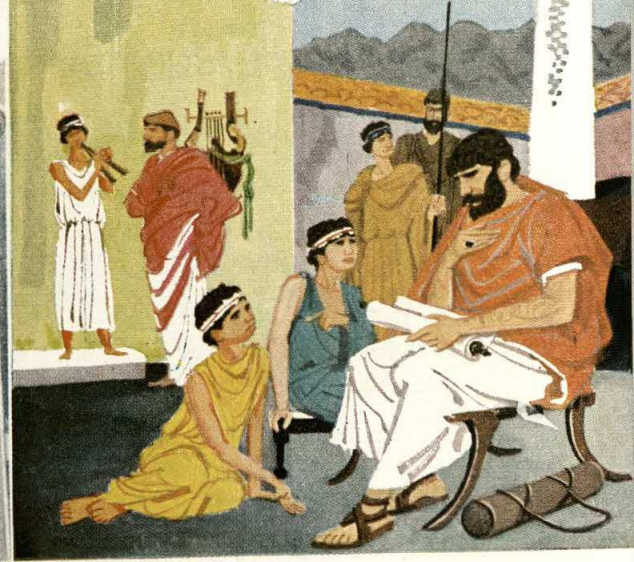
The Arts. Ancient Greece produced artists in many fields whose works are still admired for their beauty and technical excellence. Unfortunately, most of their original works have been lost. But archaeologists continue to recover early copies of Greek statues and paintings, and occasionally even a Greek original.

Literature was undoubtedly the Greeks' greatest single contribution to Western civilization. Theirs was the first literature in Europe, and they brought it to such perfection that it has been an inspiration for most later authors in the Western world. For the story of how it grew, see GREEK LITERATURE.

EVERYDAY LIFE IN ANCIENT GREECE



At the Fountain House, women filled clay water jars for use in their homes. Water came from a spring or reservoir.



Schools in Athens taught young boys to read, write, count, and play the lyre. Teachers used scrolls or wax tablets. The academies taught geography, history, and the sciences. The ancient Greeks devoted more time to physical training than to schooling.

Architecture. Greek architects showed great skill in designing temples and public buildings. They carefully fitted marble or limestone blocks together without cement. They used graceful columns to support the roofs of temples, giving their buildings a pleasing outside appearance. There are three *orders*, or styles, of Greek architecture: *Doric*, *Ionic*, and *Corinthian* (see **COLUMN**). The fortress of Athens, called the *Acropolis*, contains the most famous Greek buildings: the Parthenon, the Propylaea, and the Erechtheum (see **ACROPOLIS; PARTHENON**). Olympia, Samos, Ephesus, Agrigentum, and many other city-states had famous temples which were built with columns of one of the three orders.

Sculpture. Greek sculptors used both marble and bronze. The greatest sculptors of the 400's B.C. included Myron, Phidias, and Polyclitus. Some sculptures by Phidias are still in the Acropolis. Others are in the British Museum in London. The 300's B.C. produced such famous sculptors as Lysippus, Praxiteles, and Scopas. Their works were more realistic, and less ideal-

ized, than the works of the 400's B.C. (see **SCULPTURE**).

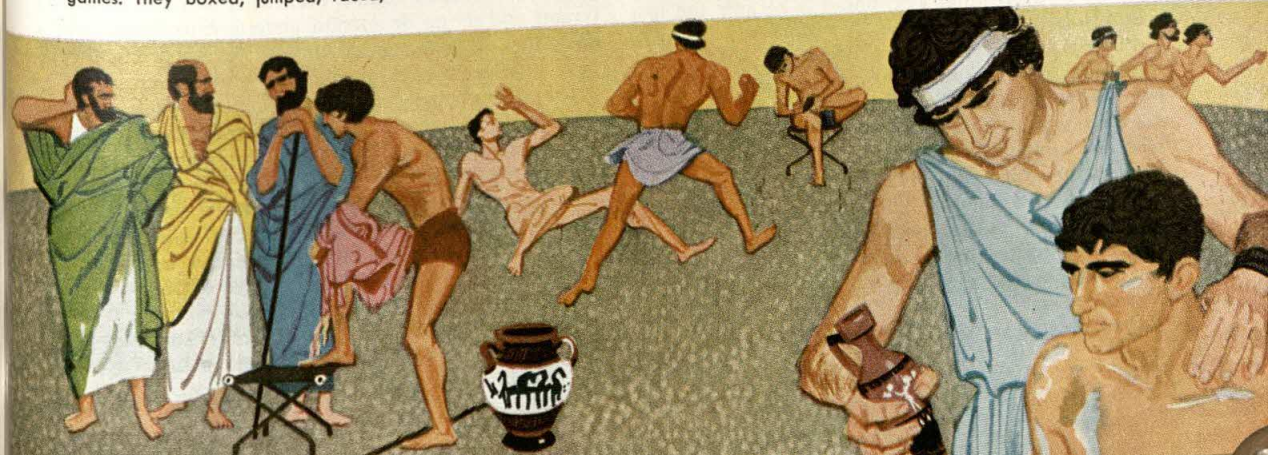
Painting. Greek painters were more famous in ancient times than Greek sculptors, but all their greatest works have perished. Only on Greek vases have some original works been preserved. Vase painters worked so skillfully that it is hard to remember that they were usually humble workmen, not great artists. It is even harder to imagine how impressive the paintings of artists such as Apelles, Polygnotus, and Zeuxis must have been.

Music in ancient Greece was played on a solo wind or stringed instrument to the accompaniment of a strong rhythmical beat. Favorite instruments included the lyre, the *cithara*, which resembled a lute, and the *aulos*, a pipe somewhat like an oboe. The Greeks greatly enjoyed singing, and wrote many poems as songs with a lyre accompaniment. They called this poetry *lyric*.

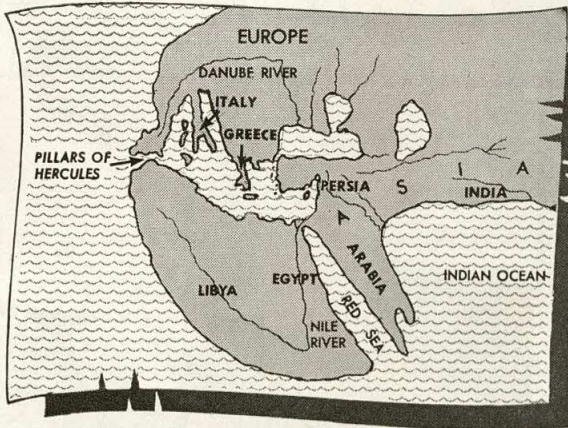
Philosophy and Science. The Greeks were the first people to ask, "What is the world made of? Why is it the way it is?" The earliest philosophers sought the one basic thing from which the whole world is made. One

In Gymnasiums, the Greeks practiced their favorite sports and games. They boxed, jumped, raced, wrestled, and threw the

discus or the javelin. Men gathered at the gymnasiums to watch the athletes and to discuss philosophy, politics, and the day's events.



HISTORY MAPS OF ANCIENT GREECE



In the 400's B.C., Herodotus, a Greek historian, drew a map showing the world as only the lands around the Mediterranean Sea.



Before City-States Developed, invading tribes ruled Greece. Aeolians came first, then Ionians. Dorians came by 1050 B.C.

philosopher, Democritus, suggested an atomic theory that is surprisingly similar to scientific views today.

The *Sophists*, an extremely clever group of teachers in Athens, argued that truth is a matter of individual opinion. Socrates set out to prove the Sophists wrong. He became the first man to demonstrate that knowledge comes through general abstract ideas called *concepts*, such as whiteness and hardness. He always sought truth, and tried to lead Athenians to nobler moral lives (see SOCRATES). Plato, Socrates' most gifted pupil, developed the first all-embracing system of philosophy, based on his theory of *ideas* (see PLATO). Plato's pupil, Aristotle, developed a system that came as close to giving final answers to philosophical questions as any philosophy of later times (see ARISTOTLE).

Later philosophers studied only ethics, or right conduct, and tried to define man's happiness. The *Stoics* believed that living according to reason is happiness, and that everything else is unimportant. The *Epicureans* believed that pleasure is happiness. The *Skeptics* concluded that nothing matters at all.

The sciences, based on research and experiment, did not develop in Greece until the late 300's B.C. Hippocrates is called "the father of modern medicine," but he based his work on careful observation, rather than experiment (see HIPPOCRATES). Aristotle was the father of Greek science. He insisted that scientists should apply careful inductive reasoning in their studies (see INDUCTIVE METHOD). He founded scientific zoology, and his pupil Theophrastus became the first scientific botanist.

Ptolemy I, who became king of Egypt after Alexander the Great died, founded a museum and library in Alexandria in the 280's B.C. For hundreds of years, it served as a research center. Euclid wrote his geometry text, *Elements*, in Alexandria. Many other Greeks studied there, including Hipparchus, the inventor of trigonometry; Apollonius, the discoverer of conic sections; and Herophilus, who specialized in experimental anatomy. Archimedes, who invented the water screw and discovered specific gravity, probably studied at Alexandria.

During Roman times, the Greek geographer Era-

tosthenes correctly calculated the diameter of the earth. Galen laid the foundation of physiology with his experiments (see GALEN).

Government

The City-State. The earliest form of government in ancient Greece was the tribe. In most areas, the tribes eventually united under one government called a *polis*, or city-state (see CITY-STATE). The city-state was a natural development in the isolated areas of Greece. Each large settlement and the surrounding villages and countryside formed a unit. Every island also had its own government.

The city-state resembled a modern city in size, and a modern nation in its independence. Laws limited the authority of public officials and regulated government activities. Each Greek citizen owed his allegiance to his own city-state. Only male citizens could vote.

Aristocrats ruled the city-states for many years. In many cities, a champion of the people finally overthrew the aristocrats and became dictator. The Greeks called these men *tyrannoi*, from which the word *tyrant* is derived. But the first tyrants were often capable men who greatly improved conditions in their cities. The tyrants represented a step toward democracy, because they depended for their power entirely on the support of the people. The sons and grandsons of tyrants often had less ability than their parents, and did not rule as wisely. Most city-states eventually threw out their tyrants and set up democratic governments. Historians know how Athens and Sparta were governed, but they have little knowledge of other city-state governments.

The Government of Athens went through many changes in democratic forms. The best-known government was based on a constitution worked out by the statesman Cleisthenes in 508 B.C. This government consisted of 9 rulers called *archons*, 10 generals, a citizen assembly called an *ekklesia*, and a council, or *boule*, that was divided into 10 executive committees called *prytaneis*. A complicated system of people's law courts administered justice. All officials except generals were chosen annually by drawing lots. Generals were elected. Unpopular politicians could be banished for



Athens dominated its allies in a league formed against the Persians in the 470's B.C. Dependent states paid tribute to the league.

10 years by a vote of *ostracism*, but they did not lose their citizenship (see BALLOT [Ancient Customs]).

The Government of Sparta was based on a constitution attributed to the magistrate Lycurgus (see LYCURGUS). The constitution remained unchanged for hundreds of years. Sparta had two hereditary kings who also served as generals, a council of 30 men called a *gerousia*, and a citizen assembly called an *apella*. But most power rested in the hands of five *ephors*, the chief justices and executive officers. The *apella* elected the *ephors* each year.

History

3000-1100 B.C. The Minoan civilization on the island of Crete and the Helladic civilization on the Greek mainland rose and fell.

800? B.C. Homer composed the *Iliad* and the *Odyssey*.

776 B.C. The first Olympic Games were held.

490 B.C. The Greeks threw back the first Persian invasion at the Battle of Marathon.

480 B.C. The Athenians defeated the Persian fleet at Salamis.

461-431 B.C. During the Golden Age of Athens, the Greeks produced their greatest arts.

431-404 B.C. Sparta defeated Athens in the Peloponnesian War.

371 B.C. Thebes defeated Sparta in the Battle of Leuctra.

362 B.C. Thebes collapsed after the Battle of Mantinea.

338 B.C. Philip II of Macedonia defeated the Greeks and made Greece part of the Macedonian Empire.

334-331 B.C. Alexander the Great conquered the Persian Empire with an army of Macedonians and Greeks, and the Hellenistic Age began.

197 B.C. The Romans conquered Macedonia and Greece for the first time.

147-146 B.C. Greece became a Roman province, and the Hellenistic Age ended.

(For later dates, see BYZANTINE EMPIRE; GREECE [History]; ROMAN EMPIRE; TURKEY [History].)

Minoan Civilization developed on Crete, the largest island in the Aegean Sea. It was the first civilization in the region of Greece. The early Cretans discovered how to make bronze about 3000 B.C. About 1,300 years later, they learned how to build ships sturdy enough to reach Egypt. From then on, they made rapid progress. They created beautiful pottery and



After the Peloponnesian War (404 B.C.), Sparta became the strongest Greek city-state. But in 371 B.C. Thebes defeated Sparta.

jewelry, and soon developed a flourishing trade with Egypt. The Cretans built an elaborate palace at Knossos for King Minos (see AEGEAN CIVILIZATION).

The sea protected Crete from attack for many years, and the Minoans were unusually peaceful. About 1600 B.C., Greeks from the mainland captured Knossos. About 400 years later, a second group of invaders destroyed most of the Minoan civilization. In later times, the Greeks had only dim memories of the Minoans in legends about a *labyrinth*, the home of a monster called the *minotaur* (see LABYRINTH; MINOS; MINOTAUR).

Helladic Civilization, or the Greek *Bronze Age*, developed in Hellas, the mainland of Greece. About 1500 B.C., the people began to build large fortified cities, because the sea did not shield them from attack. Late Helladic civilization is often called *Mycenaean*, because Mycenae, in southern Greece, was the largest city. Agamemnon, the legendary king of Mycenae, was the richest and most powerful ruler on the mainland. Homer called the Helladic peoples *Achaean*s.

The Helladic peoples of Mycenae and Pylos wrote on clay tablets in characters that were not deciphered until A.D. 1953. Scholars then discovered that this language was an early form of Greek. This discovery proved that the Helladic peoples, not later invaders, were the true ancestors of the Greeks.

According to tradition, the Helladic peoples fought against Troy, in Asia Minor, from 1194 to 1184 B.C. Homer sang of the war in the *Iliad*. If this war actually took place, it was the last spark of Helladic military power. Not long afterward, waves of migrating tribes submerged Helladic civilization.

The Period of Invasions. Invaders swept into Greece from the north. A group called the *Aeolians* occupied Thessaly and Boeotia. When these areas became crowded, the Aeolians moved eastward across the Aegean Sea to Lesbos and Chios. The next group of migrants moved into Attica, where they intermarried with the people there and formed a group called the *Ionians*. When Attica became overpopulated, some Ionians also crossed the Aegean and settled on the western shore of Asia Minor, later called *Ionia*.

The Aeolians and Ionians took many years to com-

GREECE, ANCIENT

plete their conquests. Another group of invaders, the *Dorians*, swept swiftly and violently into Greece about 1050 B.C. They conquered nearly all the Peloponnesus, and the earlier inhabitants fled into the mountains or crossed the sea to Cyprus. At the end of these migrations, the Peloponnesus was mostly Doric, central Greece was largely Ionic, and northern Greece was predominantly Aeolic. These years of invasion and migration are often called *The Dark Ages* of ancient Greece.

Greek Colonization. By 750 B.C., Greece had become overpopulated once more, and again the people decided on overseas emigration. The Ionians emigrated northeastward to the Black Sea, the Dorians colonized Sicily and southern Italy, and the Aeolians traveled as far as France and Spain. Many famous cities, including Istanbul, Lisbon, Marseille, Naples, Odessa, and Syracuse, were first settled as Greek colonies.

Only Sparta chose to solve its overpopulation problem by war rather than by colonization. The Spartans attacked Messenia, in the southwestern Peloponnesus, in 736 B.C. After a 20-year struggle, Sparta conquered Messenia and made *helots*, or serfs, of the Messenian people.

The Greek colonies traded with their home cities, and sent great wealth to Greece. But the aristocrats who controlled the city governments gained most of the profits. As the rich grew richer, the poor became more and more discontented. They supported the tyrants, taking steps that led to democratic government.

The Persian Wars. Cyrus the Great conquered Asia Minor in 546 B.C., and Persia became the strongest military power in the world. Darius I of Persia put down a revolt of the Greek colonies in Asia in 499 B.C., and organized a huge army to invade Greece. A storm off Mount Athos wrecked his fleet in 492 B.C. But another great Persian army crossed the Aegean Sea in 490 B.C. An outnumbered army of Athenians decisively defeated the Persians on the plain of Marathon (see *MARATHON*).

The Athenian victory hurt Persia's military prestige, and the Persians tried a second time to conquer Greece. An enormous Persian army under Xerxes, Darius' son, crossed the Hellespont in 480 B.C., and marched into Greece. For the first and last time, the leading Greek city-states united to fight a common enemy. After the Persians overwhelmed a tiny Spartan force at Thermopylae, they captured Athens and burned the Acropolis. But the Athenians defeated a supporting Persian fleet in a great naval battle at Salamis. A united Greek force at Plataea defeated the Persian army in 479 B.C. A third Greek victory at Mycale completed the Persian defeat. See *SALAMIS*; *THERMOPYLAE*.

The Persian Wars marked a great turning point in world history. If the Persians had won, they might have conquered Europe, and Persian culture might have become the basis of Western civilization.

The Golden Age of Athens. At the end of the Persian Wars, Athens became the strongest naval power in Greece. The Athenians organized a league of city-states for protection, but no new war came.

The period from 461 to 431 B.C. is called the *Golden Age of Athens*, because the Athenians produced their greatest sculpture, architecture, and drama during these years. This period is also sometimes called the

Age of Pericles. Pericles came to power in 461 B.C., and Athens became the intellectual and artistic center of Greece under his leadership (see *PERICLES*). The Athenians built the Parthenon with tribute-money they collected from their allies. Herodotus wrote history. Aeschylus and Sophocles wrote tragedies, and Aristophanes produced comedies. See *AESCHYLUS*; *ARISTOPHANES*; *HERODOTUS*; *SOPHOCLES*.

The End of the Classical Period. As the power of Athens grew, Corinth, Megara, and Sparta became fearful and envious. In 431 B.C., Sparta led the Peloponnesians in declaring war on Athens. The historian Thucydides wrote an account of the war that ranks among the world's great literary works. Socrates wrote and taught during this period. Euripides wrote many fine dramas. Athens fell in 404 B.C., and its Golden Age ended. See *PELOPONNESIAN WAR*; *THUCYDIDES*.

Sparta assumed leadership of the Greek city-states in 404 B.C., but it ruled so severely that the other city-states became dissatisfied. In 371 B.C., the Thebans defeated the Spartans at Leuctra and took over the leadership of Greece for several years. The Thebans freed the Messenian helots, but accomplished little else.

A period of political decay and weakness followed, but Athens held unquestioned cultural leadership. The greatest philosophers, Aristotle and Plato, wrote and taught. Isocrates and Demosthenes won fame as orators.

While Greece was declining in power, Macedonia, to the north, steadily grew stronger. Philip II of Macedonia gradually extended his power southward. Demosthenes warned the Greeks of their danger in his eloquent *Philippics*, but they rallied much too late. The Macedonians defeated the Greeks at Chaeronea in 338 B.C. Philip II reorganized Greece as part of a union with Macedonia (see *MACEDONIA*; *PHILIP II*).

The Hellenistic Age. In 334 B.C., Alexander the Great, Philip's son, attacked the Persian Empire with an army of Macedonians and Greeks. Within 10 years, he conquered an area almost the size of the United States. He recognized and admired Greek traditions and achievements, and founded Greek cities everywhere he went, including Alexandria, Egypt. By spreading Greek civilization and language, Alexander profoundly affected the history of the world. Greek culture rapidly became a world culture. The period that followed Alexander is called the *Hellenistic Age*.

After Alexander died in 323 B.C., Macedonia gradually became weaker. Many Greek city-states took advantage of this weakness to unite in independent leagues. The chief leagues were the Aetolian, in central Greece, and the Achaean, in the Peloponnesus. Each member city-state sent delegates to league meetings. These leagues were the world's first attempt at representative democracy.

Roman Rule. The Romans easily conquered Macedonia and Greece in 197 B.C. But the next year, in a surprise move, they proclaimed "the freedom of Greece" and withdrew. But Macedonia would not follow Roman wishes, so the Roman army returned in 167 B.C., and abolished the Macedonian kingdom. Finally, in 148 B.C., Macedonia became a Roman province. The Achaean League also disobeyed Roman orders, and Roman armies swept into southern Greece, destroying the chief city, Corinth, in 146 B.C. Greece became a Roman province, *Achaia*.

WORK AND CRAFTS OF ANCIENT GREECE

Greek Coins came into use about 600 B.C. Each city-state made its own coins. Silver coins from Athens, made about 400 B.C., picture the goddess Athena and her sacred owl.

Metropolitan Museum of Art, N.Y.



Greek Farmers harvested olives during the fall and winter. They struck the trees with long rods to shake down the fruit. Then they mashed the olives for oil and took jars of oil to town for marketing. The Greeks used olive oil for food and as soap. Farmers also raised sheep.



Paintings on Greek Vases show scenes of everyday life and of mythology. The vase above pictures a blacksmith at work in his shop. Another, left, shows a carpenter drilling a hole in a wooden chest. Greek potters are believed to have invented the potter's wheel.

Museum of Fine Arts, Boston

GREECE, ANCIENT

Between 146 and 27 B.C., the Romans completed their conquest of the Hellenistic world. For a time, Greece prospered. Delos became a center of international commerce. But, in 88 B.C., Mithridates of Pontus destroyed Delos when he tried to drive the Romans from Greece. The Romans defeated him, capturing Athens and burning its shipyards. Roman leaders then fought three civil wars on Greek soil. During these wars, the Greeks lost most of their wealth.

In spite of these setbacks, Greek civilization continued to spread. The Romans adopted Greek culture. Greek traditions lived on not only in Greece, but also in the writings of Roman orators and poets such as Cicero, Horace, and Virgil. Under Roman rule, Greece enjoyed 300 years of unbroken peace (see ROMAN EMPIRE). The country slowly recovered its wealth. The Romans rebuilt Corinth and made it the capital of the province.

Christianity began to spread in Greece, especially among the slaves and the poor. In A.D. 330, Constantine the Great moved the capital of the Roman Empire from Rome to the former Greek colony of Byzantium, changing its name to Constantinople. The empire was divided into eastern and western halves in A.D. 395, and Greece became part of the East Roman, or Byzantine, Empire. The Byzantine Empire represented the second great period in Greek history. It lasted for more than 1,000 years and produced a remarkable civilization of its own (see BYZANTINE EMPIRE).

The Byzantines were unable to protect the Greek mainland from fierce tribes from the north. The history of Greece in Byzantine times is one of constant invasion. The Byzantine Empire finally collapsed when the Ottoman Turks captured Constantinople in A.D. 1453.

For the story of Greece after the Roman conquest, see BYZANTINE EMPIRE; GREECE (History); ROMAN EMPIRE; TURKEY (History).

JOHN HARVEY KENT

Related Articles in WORLD BOOK include:

BIOGRAPHIES

An alphabetical list of biographies relating to Ancient Greece appears under Greece, Ancient, in the BIOGRAPHY section of the READING AND STUDY GUIDE.

CITIES

Athens	Delphi	Knossos	Sparta
Corinth	Dodona	Mycenae	Thebes

CONTRIBUTIONS TO CIVILIZATION

Acropolis	Greek Literature
Aegean Civilization	Iliad
Aesop's Fables	Music
Architecture	Odyssey
Astronomy	Painting
Character Education	Parthenon
Clothing (color pictures)	Philosophy
Column	Physics
Dancing	Science
Drama	Sculpture
Education, History of	Seven Wonders of the World
Fairs and Expositions	Shelter (Homes in Ancient Civilizations)
Family	Slavery (Slavery in the Ancient World)
Food (Early Civilizations)	Textile (Greek and Roman)
Furniture (Greece)	Theater (Ancient)
Geography	
Geometry	
Gravity, Specific	
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DIVISIONS

Arcadia	Bocotia	Laconia	Messenia	Thrace
Attica	Epirus	Macedonia	Thessaly	

GOVERNMENT

Archon	Citizenship (History)	Government
Areopagus	City-State	Law (Law of the Ancient Greeks)
Athens (Government; History)	Democracy	Tribe
Ballot		

HISTORY

Achaean	Iran (Classical Period)	Roman Empire
Aeolian	Marathon	Salamis
Barbarian	Olympia	Thermopylae
Byzantine Empire	Olympiad	Troy
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Ionian		

MYTHOLOGY

Acolus	Minos	Oracles
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Hades	Mythology	Trojan Horse
Labyrinth	Olympus	

Outline

- I. The Land and Its Resources
 - A. Location and Size
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 - C. Natural Resources
 - D. Climate
- II. Life of the People
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- III. Work of the People
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 - D. Transportation
 - E. Communication
- IV. Activities of the People
 - A. Education
 - B. Religion
 - C. The Arts
 - D. Philosophy and Science
- V. Government
- VI. History

Questions

How did ancient Greek education differ from education in the United States and Canada?
Why did the Greeks found so many colonies?
What is considered the greatest single contribution the ancient Greeks made to our civilization?
What was a city-state? Why did city-states develop?
Could Socrates read a modern Greek newspaper?
What kinds of gods did the Greeks believe in?
Why was there no national government in ancient Greece?
What do historians consider the world's first serious attempt at representative government?
Why are the Persian Wars considered a great turning point in world history?
What was an aristos? A chiton? A trireme?

GREEK CHURCH. See EASTERN ORTHODOX CHURCHES.

GREEK CROSS. See CROSS.

GREEK FIRE is an inflammable chemical mixture which burns furiously, even under water. The Byzantine Greeks of the Middle Ages used it to set fire to enemy fleets, and to defend Constantinople. Its composition was a secret. Saltpeter is believed to have been used in an early mixture. By the 1200's, it was probably much like gunpowder, then unknown.

GREEK GAMES. See ISTHMIAN GAMES; NEMEAN GAMES; OLYMPIC GAMES; PYTHIAN GAMES.

GREEK GODS. See MYTHOLOGY.

GREEK LANGUAGE is a branch of the Indo-European family of languages. It is related to Latin and Sanskrit, Old Slavic, Celtic, and the Germanic languages. Many persons regard ancient Greek as the most beautiful and effective language ever spoken. Its sound was a musical chant, instead of the monotone of most languages. With its many *inflections*, or changes in word forms, it could express ideas more exactly than less inflected languages. For example, a fully inflected classic Greek verb had more than 500 different forms. Each change in form showed a change in the time, the manner or kind of action, or the person acting.

Greek has great interest for students of English because many of our words come from Greek, often through Latin or one of the Romance languages. Scientific words from Greek include *atom*, *biology*, *botany*, *economics*, and *zoology*. Among Greek words used in the arts are *architecture*, *criticism*, *drama*, *music*, and *poetry*.

Alphabet

Most of the alphabets of modern Europe are taken from the Greek, which was in turn adapted about 1000 B.C. from the alphabet of the Phoenicians. There are

Greek Alphabet	English Sound	Greek Alphabet	English Sound
A α	alpha arm	N ν	nu now
B β	beta but	Ξ ξ	xi ax
Γ γ	gamma get	Ο ο	omicron for
Δ δ	delta do	Π π	pi pie
E ε	epsilon held	Ρ ρ	rho ran
Z ζ	zeta adze	Σ σ,ς	sigma sat
H η	eta they	Τ τ	tau tar
Θ θ	theta thin	Υ υ	upsilon rude
I ι	iota machine	Φ φ	phi fill
K κ	kappa kite	Χ χ	chi elkhorn
Λ λ	lambda lamb	Ψ ψ	psi upset
M μ	mu man	Ω ω	omega hold

English sounds represent those of ancient Greek.

two forms of the Greek alphabet, the western and the eastern. From the western comes the Roman alphabet in which this book is printed. The eastern alphabet is used in classical and modern Greek, and was the ancestor of the Cyrillic alphabet, used in Russia and other nations of eastern Europe (see **RUSSIAN LANGUAGE**).

The Greek alphabet has 24 letters. Its consonants were pronounced about like those in English, but the vowels sounded more like those of German. Greek had no *h*. Its sound was shown by ' over or preceding a vowel beginning a word, as 'Αἰδης (pronounced *hah dayce*), meaning *Hades*. Most Greek words had accent marks to show a rising, falling, or sustained pitch.

Scholars believe that people began to write in the Greek alphabet about 1000 B.C., but the oldest surviving inscriptions date from the 800's B.C. Greek writing at first went from right to left. Later, one line went from right to left, the next from left to right in a form called *boustrophedon*, "like plowing oxen turning." After about 500 B.C., all lines went from left to right.

History

Ancient Greek. The geography of Greece greatly influenced the development of its language. Mountains

GREEK LETTER SOCIETY

and deep bays isolated one group and region from another. Because of this isolation, the Greeks used many different dialects before writing was introduced.

Some Common Words in Ancient Greek

GREEK	ENGLISH SPELLING	PRONUNCIATION	MEANING
ἄνθρωπος	anthropos	ahn throh poss	man
βιβλίον	biblion	beeb lee on	book
γῆ	ge	gay	earth
γράμμα	gramma	grahm mah	letter
δένδρον	dendron	dehn dron	tree
ἡμέρα	hemera	haym ehr ah	day
κόσμος	cosmos	koss moss	world
λόγος	logos	lo goss	word
μέγας	megas	meh gahs	large
μήν	men	mayn	month
μήτηρ	mater	mayt ayr	mother
μικρός	mikros	mee kross	small
μόνος	monos	mo noss	single
οἰκία	oikia	oy kee ah	house
πατήρ	pater	paht ayr	father
πολύς	polys	po loos	many, much
φίλος	philos	fee loss	friend

But the dialects never differed so much that the Greeks of one region could not understand those of another. The dialects of historic times fall into three divisions—Aeolic, Doric, and Ionic. Aeolic and Ionic are believed to have developed from a common source, Achæan. Ionic included Attic, the language of Athens, which became the chief literary language. The oldest Ionic writings are Homer's epic poems, the *Iliad* and the *Odyssey*. His Ionic contains many Aeolic words and forms, and was read and understood throughout Greece. Later, the great dramatists and prose writers used Attic. It became the standard of classic Greek.

After Alexander's conquests, people from Europe to India spoke and wrote a simplified Attic known as *koine*, or common dialect. Plutarch used it in his *Parallel Lives of Illustrious Greeks and Romans*, and the New Testament is written in it. Greek in this form was the common language of cultured men of all nations from 300 B.C. until the barbarians overran Europe.

Modern Greek began to take shape about A.D. 800. It was the language of the Byzantine Empire, and remained in use in Greece after the Turks conquered the Byzantines in 1453. Today about 8,000,000 persons speak Greek. When printed, modern Greek closely resembles the ancient *koine*. A reader of modern Greek can read the ancient dialect about as well as we do Shakespeare. In pronunciation, modern Greek is quite different from ancient. The language today has two main forms: *katharevusa*, a literary language; and *demotike*, the popular speech. The latter has dropped many inflections, changed some forms, and added words from other modern languages.

GEORGE R. GRIFFIN

See also **ALPHA AND OMEGA**; **ALPHABET**; also the articles on each letter of the English alphabet appearing at the beginning of each letter in **THE WORLD BOOK ENCYCLOPEDIA**.

GREEK LETTER SOCIETY. See **FRATERNITY**; **SORORITY**.

GREEK LITERATURE

GREEK LITERATURE. Beginning almost 3,000 years ago, Greek authors wrote the first literature in Europe. Their poems, plays, histories, and speeches have rarely been excelled in beauty, originality, or variety by peoples of any other time or country. All regions and dialects of ancient Greece contributed to this great achievement. The thoughts expressed in Greek literature had tremendous influence upon such later writers as Virgil, Dante, and Shakespeare.

Characteristics of Greek Literature

The Greeks never developed a unified government, but they created a remarkably unified literature. In a world where few changes of thought or custom appeared for hundreds of years, the Greeks clung to their individuality. Every Greek had his own opinions on everything, and delighted to express and defend them. He took part in an active and ever-changing life, a continual debate and war of ideas in all areas of human activity.

Greek writers fought in the forefront of this mental battle. In addition to their writing, they had practical roles in society. As the nation's first thinker and teacher, the great poet Homer "educated all Greece." The famous lawmaker Solon first won fame for his elegiac verse. And Plato was not only a great philosopher, but also a matchless prose stylist.

Language and Form. Greek literary forms developed naturally from their native dialects—Aeolian, Dorian, and Attic. First, the Ionic descendants of the Aeolians produced the *Aeolic epic* dialect. All epic poets, regardless of their tribe, used this dialect. The later Ionians developed the *elegiac* couplet, superbly suited to express strong passions. The *Doric* dialect, massive and sonorous, proved perfect for choral and religious odes. The *Attic* dialect, spoken in Athens, took the best elements from all the others. Through this flexible, efficient, and beautiful language, the Greeks expressed their abundance of sublime human feelings and deep thoughts on life.

In Translation, Greek literature has affected most other literatures. For example, Latin literature began with the translations of a Greek, Livius Andronicus, in the 200's B.C. His version of Homer's *Odyssey* became a chief textbook for Roman schoolboys of the next 200 years. In poetry, he used the Greek system of *quantitative* meter (based on the long and short vowel sounds in syllables), rather than the native *accentual* meter (based on the force of the syllables themselves) natural to Latin. As a result, Latin classical poetry used quantitative meter during its entire history.

We owe as much to translations from the Greek as the Romans did. Plutarch's *Lives*, as translated by Sir Thomas North in the late 1500's, suggested to Shakespeare many characters, settings, and plots. The same work influenced many others, including Percy B. Shelley and Thomas Jefferson.

Not all English translations are equally good. The English translations of Homer's works written in the 1500's by George Chapman and the 1700's by Alexander Pope now seem strange to us, and almost conceal the true Homer. Other versions lack the force and fire in which Homer excelled. But some translations of Greek

works have become English classics in their own right. They include Sir Richard Jebb's versions of Sophocles, Benjamin Jowett's translations of Plato, and Gilbert Murray's renderings of Greek verse.

Early Greek Literature

The Epic Age began before written history and lasted through the 800's B.C. From earliest times, Ionian and Aeolian *bards*, or wandering poets, had chanted stories of the heroic deeds of their Achaeans ancestors in the courts of Greek rulers. Homer, who probably lived near the end of this period, wove some of these tales into two immortal epics, the *Iliad* and the *Odyssey*. These aristocratic, warlike epics represent the spirit of the rulers of Greece in the 1100's B.C. They are written in *dactylic hexameter*, lines that have six feet, each usually consisting of three syllables. Henry Wadsworth Longfellow imitated this meter in *Evangeline*, read slowly with light stresses (see METER [poetry]).

Other epic poets filled out Homer's tales with the adventures of various heroes of the Trojan War. These *Cyclic poets* also wrote in dactylic hexameter, which became the standard meter for epic poetry.

Hesiod of Boeotia, who probably lived after Homer, wrote two *didactic*, or teaching, epics. They represent the philosophical and democratic thought of the 1000's B.C. One, *Works and Days*, teaches how to attain happiness through hard work and thrift, and lists the correct seasons and methods for farm work. The other, *Theogony*, is a story of the creation of the world, and a systematic account of the relations among the gods.

The Lyric Age lasted from about 800 B.C. to about 475 B.C. The musical poetry that characterized this period was called *lyric*, because it was sung to the accompaniment of the lyre or the flute. It includes three basic types: the *melic*, sung to the lyre; the *elegiac*, with flute accompaniment; and the *iambic*, which was recited rather than sung. Most lyric poems express the poet's feelings on a single idea or event. For example, in the 600's and 500's B.C. Callinus and Tyrtaeus wrote on war and courage, and Theognis praised high moral conduct, justice, and goodness. Archilochus, who probably lived about 700 B.C., perfected the iambic meter in his highly satirical poems. Greece's greatest woman poet, Sappho of Lesbos, lived about 600 B.C. She sang of love in all its aspects, sad and gay. During the late 600's and early 500's B.C., Alcman and Stesichorus composed noble victory odes. Simonides of Ceos (556-469 B.C.) mastered not only the lyric, but also the short, witty epigram. Pindar (522?-443 B.C.) wrote splendid triumphal odes to celebrate war victories and athletic triumphs in the great festival games.

Other lyric poets of the 600's include Alcaeus, fiery and patriotic, and Mimnermus, who set the tone for later melancholy love elegies. Anacreon, in the 500's B.C., wrote about love and praised wine. Corinna, the famous woman poet of Thebes, taught Pindar in his youth. A little later, Bacchylides challenged Pindar in imagination, if not in splendor and power.

The Golden Age

The period in Greek history from the 470's to about 300 B.C. was one of the most glorious in the history of Western civilization. Athens, and finally all Greece, developed great artists of every kind. In literature, this

period is called the *Attic Age*, because literary life centered in Athens.

Drama reached great heights in the works of Aeschylus (525?-456 B.C.), Sophocles (495-406 B.C.), and Euripides (480?-406? B.C.). Aeschylus wrote about 90 tragedies, of which 7 remain. Sophocles united the highest qualities of Greek genius. No dramatist has surpassed his sublime conceptions of the possibilities of human nature. The plays of Euripides are more contemporary in feeling. His heroines have the most appeal for us, and many later dramatists and novelists have imitated them.

Aristophanes (445-385 B.C.), the foremost writer of ancient Greek comedy, produced his plays during this period. He combined personal and political criticism of his age with delightful fantasy and wit.

Other Forms. The historians of the Attic period made great contributions. Herodotus (484-424 B.C.), often called "the Father of History," wove many stories into his history of the Persian Wars. Thucydides (460?-400? B.C.) related causes to effects, and motives to events, in his account of the Peloponnesian War. He is often called the first scientific historian. Xenophon (434?-355? B.C.) wrote the *Anabasis*, describing the famous retreat of 10,000 Greek soldiers through Asia Minor.

Orators of the Attic period urged the Greeks to greatness. They included Lysias, who died about 380 B.C., Isocrates (436-338 B.C.), Aeschines (389-314 B.C.), and Demosthenes (384-322 B.C.). At the same time, Plato (427?-347 B.C.) stated and expounded the teachings of the great philosopher Socrates (469?-399 B.C.). Plato's pupil Aristotle (384-322 B.C.) won fame as a philosopher, scientist, and literary critic.

Later Greek Literature

The Alexandrian Age includes the period from about 300 B.C. to 146 B.C. Alexander the Great had conquered most of the known world, spreading Greek culture as far as India. Alexandria, the city he founded in Egypt, became the center of Greek thought. Science, scholarship, and criticism flourished, rather than creative writing. Even the poetry of the age was graceful and erudite, not emotional or imaginative. One of the best poets of the time, Callimachus (305?-240? B.C.), was a librarian and critic by profession.

Theocritus of Syracuse, who lived in the 200's, made the major original contribution to the times. He created a new form, the pastoral *elegy*, which sings of shepherds and nymphs. Moschus, of the 150's B.C., and Bion, of the 100's B.C., imitated his style. These three set the pattern for all later pastoral poets.

The dramatists of the age included Alexis (372?-270 B.C.), Diphilus (born about 340 B.C.), Menander (342-291 B.C.), and Philemon (361?-262? B.C.). They wrote urbane comedies of manners, making fun of human follies and foibles. Their plays are called *new comedy* to distinguish them from the *old comedy* written by Aristophanes. Herodas, who lived in the 200's B.C., wrote the *Mimes*, showing how the common people of the time lived and what they thought.

Aristarchus (217?-145? B.C.), by his careful criticism and editing of the great classics, started the sciences that have preserved much noble writing that would otherwise have been lost or corrupted. This age also

produced Euclid, whose geometry became the foundation for 2,000 years of work in that field.

The Graeco-Roman Age began when the Romans conquered Greece in 146 B.C., and ended about 675 years later. Greek writers produced a huge number of works. Athens, under Roman patronage, regained its prestige as a university city. Every learned Roman knew Greek literature, and Rome had its own Greek libraries. Rome attracted and favored scholars from the whole Greek world. Polybius (204?-122? B.C.) and Diodorus, who died about 20 B.C., wrote outstanding histories. Plutarch (A.D. 46-120) wrote his *Lives*, tracing parallels between famous Greeks and illustrious Romans. Galen (138?-201?) produced commentaries on medical knowledge that became standard texts during the Middle Ages. The satirist Lucian, born about 120, expressed his keen wit with great clarity of language.

The Byzantine Age, usually considered as beginning with the emperor Justinian in A.D. 529, lasted until Constantinople (now Istanbul) fell to the Turks in 1453. The great city of Constantinople became the center of Greek culture. As a part of the Byzantine Empire, Greece came in close contact with the Egyptian and Asiatic peoples from other parts of the empire. Greek civilization began to take on some of their characteristics. European Greece made only small contributions to the literature of this age. The Greeks spent their energy fighting invaders. For hundreds of years afterwards, the power of the Moslems to the south and east kept the Greek world in a state of siege.

Under the influence of Christianity, much Greek prose became theological, philosophical, and historical. Poets wrote many great hymns. Epigrams, criticism, and scholarly works flourished. Some of the most charming works appear in *The Greek Anthologies*, several collections of poems. These 6,000 poems, collected by many anthologists, cover Greek life and thought from 700 B.C. to A.D. 900.

Since About 1800, verse forms have remained more popular and important than prose in Greek literature. Many poems reproduced the themes of ancient Greek folk songs. Dionysios Solomos (1798-1857) combined dramatic power with a love for, and an understanding of, Greek folk poetry. Kostis Palamas (1859-1943) sought simplicity, the quiet tone, and the familiar in his poetry. Nikos Kazantzakis (1885-1957) combined an intellectual thirst and moral awareness with a lyrical style in his prose and poetry. GEORGE R. GRIFFIN

Related Articles. For the history of the times, see GREECE, ANCIENT; BYZANTINE EMPIRE. Other related articles in WORLD BOOK include:

BIOGRAPHIES

Aeschines	Euripides	Pericles	Simonides
Aeschylus	Herodotus	Pindar	Sophocles
Anacreon	Hesiod	Plato	Theocritus
Aristophanes	Homer	Plutarch	Thucydides
Aristotle	Isocrates	Polybius	Xenophon
Demosthenes	Lysias	Sappho	

UNCLASSIFIED

Drama (The Greek Theater)	Iliad	Orators and
Elegy	Meter (poetry)	Oratory
Epigram	Ode	Philosophy
	Odyssey	Poetry

GREEK ORTHODOX CHURCH

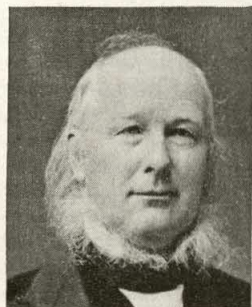
GREEK ORTHODOX CHURCH. See EASTERN ORTHODOX CHURCHES.

GREELEY, Colo. (pop. 26,314; alt. 4,665 ft.), the trading center of a farming and mining area, lies about 50 miles north of Denver (see COLORADO [color map]). Industries include beet-sugar refining and vegetable canning. Greeley, the home of Colorado State College, was founded in 1870 as a cooperative farm enterprise organized by Horace Greeley (see GREELEY, HORACE). The seat of Weld County, Greeley has a council-manager form of government.

HAROLD H. DUNHAM

GREELEY, HORACE (1811-1872), a prominent American newspaper publisher, founded and edited the *New*

York Tribune. He was a leader in the antislavery movement, and his editorials played an important part in molding public opinion, especially during the 20 years before the Civil War. Greeley's editorials against the spread of slavery into new territory increased the antislavery sentiment of the North. He also fought vigorously in his columns for the protective tariff and for antiliqur legislation.



Chicago Historical Society

Horace Greeley

Greeley's writings and remarks were widely quoted. In 1834, he founded *The New Yorker*, a weekly literary paper, which proved popular. The phrase, "Go west, young man," originated in 1851 by an Indiana newspaperman, John Soule (1815-1891), appeared in *The New Yorker* as advice to the unemployed of New York City. This phrase became a byword after Greeley popularized it.

Founds *New York Tribune*. In 1840, Greeley began publication of *The Log Cabin*, a weekly campaign paper supporting William Henry Harrison, the Whig candidate for President. The next year he founded the *Tribune*, a penny daily, and combined *The Log Cabin* and *The New Yorker* into the *Weekly Tribune*. People throughout the northern United States read the Greeley publications.

His Civil War Role. Greeley was one of the first editors to join the Republican party. He was a delegate to its second national convention, and helped Abraham Lincoln obtain the nomination for President. Although he supported Lincoln throughout the Civil War, he urged settling the conflict by compromise. In 1864, he met with several agents of the Confederacy in Canada to discuss peace terms, but the conference failed. Greeley also urged giving pardons to all members of the Confederacy after the war. He signed the bail bond of Jefferson Davis, president of the Confederacy. This action hurt Greeley's popularity and that of the *Tribune*.

His Political Role. Greeley supported the administration of President Ulysses S. Grant for two years, but then began to disagree with Grant's policies and to oppose him openly. The Liberal Republicans and the Democrats nominated Greeley to run for President against Grant, but Grant won a decisive victory in the 1872 election. Greeley died less than a month later.

Greeley was born in Amherst, N.H., on Feb. 3, 1811. He became an apprentice in a Vermont newspaper office when he was 15. He later moved to New York City, where, in 1833, he helped found the *Morning Post*, the first two-cent daily paper ever published. It ran for only three weeks. In 1870, he founded a cooperative community, Union Colony, in Colorado, later called Greeley, Colo. He wrote several books, including *Glances at Europe* (1851), *An Overland Journey to San Francisco in the Summer of 1859* (1860), *The American Conflict* (1866), *Recollections of a Busy Life* (1863), and *What I Know of Farming* (1871).

KENNETH N. STEWART

See also LIBERAL REPUBLICAN PARTY.

GREELEY, ADOLPHUS WASHINGTON (1844-1935), was an American soldier and Arctic explorer. From 1881 to 1884, he led an expedition to establish observation stations near the North Pole. The expedition made scientific observations and explored northern Greenland and Ellesmere Island. Greeley withdrew southward when relief ships failed to arrive in 1883. He lost 18 men before the expedition was rescued at Cape Sabine on the east coast of Ellesmere Island.

Greeley was born at Newburyport, Mass. He fought in the Civil War. He was assigned to the Signal Corps in 1867, and became chief signal officer in 1887. He introduced radio telegraphy to the Signal Corps. He also supervised the building of telegraph lines in the Southwest.

JOHN E. CASWELL

GREEN is one of the colors of the solar spectrum. It appears between blue and yellow. Green is one of the most common colors in nature. The grass and nearly all foliage are green. Sometimes the sea looks green, and green also appears in the mineral malachite and in emeralds. Many tropical birds have green feathers, and some butterflies are bright with green.

Green coloring matter, or *pigment*, can be made by mixing blue and yellow pigments. Most green paints and dyes result from boiling copper acetate in a solution that contains arsenic and oxygen. These paints and dyes are deadly poisons, and should be kept away from children. Most of the green dyes once made from vegetable compounds now come from coal tar. The different shades of green result from mixing the pigments in different proportions. Most green pigments fade quickly when exposed to the sun.

Green is the national color of Ireland. Scottish Highlanders wore it as a mark of honor. People wear green on Saint Patrick's Day, March 17. It is a sacred color to the Moslems, who carry a green flag. Their prayer rugs have green backgrounds. Green served as the color of repentance in ancient traditions. It is also the color of envy.

See also COLOR.

GREEN, ANDREW HASWELL. See NEW YORK CITY (Famous New Yorkers).

GREEN, DARIUS. See TROWBRIDGE, JOHN T.

GREEN, "HETTY," HENRIETTA HOWLAND ROBINSON (1834-1916), was regarded at the time of her death as the richest woman in the world. She inherited her father's estate of about \$6,000,000. Shrewd investments, chiefly in government bonds, railroad securities, and real estate, increased it to an estimated \$100,000,000. She spent little money on personal comforts. She was born in New Bedford, Mass., but moved to New York City in 1863.

JOHN B. McFERRIN

GREEN, PAUL ELIOT (1894-), an American playwright and author, became known for his plays about the South and its people. His play *In Abraham's Bosom* won the Pulitzer prize in 1927. In his historical *The Last Colony* (1937), Green experimented with symphonic drama, a combination of music, singing, dancing, and pantomime. He used this formula in all his later writings. He was born near Lillington, N.C. GEORGE FREEDLEY

GREEN, SAMUEL SWETT. See **LIBRARY** (Famous Librarians).

GREEN, THEODORE FRANCIS. See **RHODE ISLAND** (Famous Rhode Islanders).

GREEN, WILLIAM (1873-1952), succeeded Samuel Gompers as president of the American Federation of Labor in 1924, and held the position until his death. As president of the A.F. of L., Green worked for laws to help workers and unions. In foreign and domestic affairs, he called attention early to the threat of communist tactics. During World War II, he played an important part in working out the labor movement's "no-strike" pledge.

Green was born in Coshocton, Ohio, where he became a coal miner. He moved up quickly in the Ohio Mine Workers' Union, serving as local union president, district president, and international union statistician. He was elected secretary-treasurer of the United Mine Workers of America in 1913.

Green also served two years in the Ohio Senate. He served for a brief period as presiding officer. In this post, he helped pass the mine safety and workmen's compensation laws in Ohio. JACK BARBASH



Walters

William Green

GREEN ALMOND. See **PISTACHIO NUT.**
GREEN BAY is a body of water, that extends inland from Lake Michigan for about 120 miles. The bay forms part of the southern boundary of the upper peninsula of Michigan, and the northeast boundary of Wisconsin. Green Bay is about 20 miles wide. At its tip lies the city of Green Bay, Wis. Explorers and fur traders sailed up Green Bay during the 1600's. For location, see **WISCONSIN** (color map). JAMES I. CLARK

GREEN BAY, Wis. (pop. 62,888; alt. 590 ft.), is the second largest trade and shipping center in the state (see **WISCONSIN** [color map]). Only Milwaukee is larger. Green Bay lies at the mouth of the Fox River at the southern point of the body of water called Green Bay. The city is about 200 miles north of Chicago. Manufactures include paper and paper products, cheese, excavating and paper-converting machinery, and various kinds of canned foods.

In the 1600's Green Bay was a meeting point for the men who developed the Mississippi Valley. They started the first permanent settlement in Wisconsin in Green Bay in 1764. The city has a mayor-council form of government. JAMES I. CLARK

GREEN FLY, a common name for aphids. See **APHID.**

GREEN MANURE. See **AGRICULTURE** (Soils and Water); **MANURE.**

GREENAWAY, "KATE," CATHERINE

GREEN MOUNTAIN BOYS were soldiers from Vermont who fought for the American colonies in the Revolutionary War. They captured Crown Point, and helped take Fort Ticonderoga. Led by Colonel Seth Warner, these soldiers helped win the battle of Bennington.

Ethan Allen organized the Green Mountain Boys some years before the Revolution. They raided New York settlements in protest against the claims of New York to the territory of Vermont, which had been under the control of New Hampshire. The Green Mountain Boys burned the cabins of the New Yorkers, and stole their cattle. They stripped the New Yorkers and whipped them. They branded the naked backs of New York officials with the "beech seal." This is a famous phrase in Vermont, which means they beat these officials with beech goads, or pointed rods, instead of admitting their authority. In 1777, the Green Mountain Boys declared Vermont an independent republic. Their demand for statehood was granted in 1791, and Vermont became the 14th state admitted to the Union. JOHN R. ALDEN

See also **ALLEN, ETHAN**; **CROWN POINT**; **FORT TICONDEROGA**; **VERMONT** (Boundary Disputes); **WARNER, SETH.**

GREEN MOUNTAIN STATE. See **VERMONT.**

GREEN MOUNTAINS form part of the Appalachian system. They are one of the oldest mountain ranges in North America. The Green Mountains received their name from the forests of evergreens which covered the mountains when the first settlers came.

The mountains extend north and south, through the central part of the state of Vermont. They make up part of the mountain chain that continues southward through Massachusetts and Connecticut. In these two states, the mountains are known as the Berkshire Hills and the Hoosac Mountains. The northern end of this mountain chain reaches Quebec. Through millions of years, storms, water, and ice have worn down the peaks so that in some places they are low hills. The highest peak is Mount Mansfield (4,393 feet), near Stowe, Vt. For location, see **VERMONT** (color map).

Maple, ash, birch, beech, hemlock, fir, pine, and spruce trees almost completely cover the mountains. Many tourists visit this area to enjoy the scenery and pleasant climate. WALTER R. HARD, JR.

GREEN RIVER. See **UTAH** (Rivers and Lakes).

GREEN RIVER provides Kentucky's largest river basin. The basin covers 9,222 square miles, almost one fourth of the area of Kentucky. The Green River rises in Lincoln County in the center of the state. It flows west for 360 miles to the Ohio River near Henderson. Six locks and dams permit navigation of the Green River to Mammoth Cave and Bowling Green. For location, see **KENTUCKY** (color map). J. R. SCHWENDEMAN

GREEN VITRIOL. See **FERROUS SULFATE.**

GREENAWAY, "KATE," CATHERINE (1846-1901), was an English illustrator of children's books. She painted in water colors, and became known particularly for the quaint charm of her pictures, her delicate portrayal of flowers and gardens, and her flowerlike children. She often wrote her own verses to go with her drawings. Her first book was *Under the Window* (1879). Her other books include *The Language of Flowers* (1884), *Marigold Garden* (1885), and *A Apple Pie* (1886).



Culver; Historical Pictures Service

Kate Greenaway, right, often wrote verses to go with her drawings. With this quaint picture, above, she wrote:

"Little Fanny wears a hat
Like her ancient Grannie;
Tommy's hoop was (think of
that)
Given him by Fanny."



RUTH HILL VIGUERS

Miss Greenaway was born in London, the daughter of an engraver. She had become well-known for her Christmas cards, valentines, and magazine sketches before she began illustrating books.

See also VALENTINE'S DAY (picture).

GREENBACK is the popular name for the kind of United States paper money called *treasury notes*. Greenbacks do not include gold and silver certificates. They take their name from the color of their reverse side. The government first issued greenbacks under the act of February, 1862, to finance war operations. Until 1879, they circulated merely as promises of the United States to pay. They had no metal money behind them as security. At one time, when people held little confidence in the government, they were worth only 35 cents for each dollar. Since 1879, their issue has been fixed at about \$346,000,000, and the government maintains a large gold or silver reserve behind them. See also SPECIE PAYMENTS, RESUMPTION OF.

JOSEPH COFFIN

GREENBACK PARTY was an American political party that was active between 1876 and 1884. Its name referred to the *greenbacks*, or paper notes, that had been issued during the Civil War and afterward. Farm prices rose higher than ever before during this period.

After the panic of 1873, prices dropped, mortgages were foreclosed, and the amount of money in circulation dropped greatly. The Greenbackers believed that the issuance of large amounts of paper money would bring prosperity, especially to the farmer, by raising prices and making debts easier to pay. Many farmers of the West and South joined the party, or worked to promote its policies in the Republican and Democratic parties.

The Greenback party was founded at a meeting in Indianapolis, Ind., in 1874. The first party convention, held in 1876, nominated Peter Cooper for President. The party received few votes. In 1878 it succeeded in electing several congressmen. Some of these men formed a group in the House of Representatives called the "Greenback bloc." In 1880 the Greenback party broadened its platform, supporting an income tax, an eight-hour day, votes for women, and other progressive measures. It nominated James B. Weaver, leader of the bloc in Congress, as its candidate for President. The party made a poor showing in the election, and lost some of its seats in Congress. By 1888, it lacked the strength to nominate its own candidate for President. DONALD R. MCCOY

See also COOPER, PETER.

GREENBOTTLE, a fly. See BLOWFLY; BLUEBOTTLE.

GREENBRIER is a North American vine of the lily family. It has a prickly stem, blue-black berries, and broad, short, pointed leaves. People also call it *horse brier* and *cat brier*. The greenbrier grows in moist thickets from Nova Scotia to Texas. It spreads rapidly and becomes weedy.

Scientific Classification. Greenbrier belongs to the family *Liliaceae*. It is classified as genus *Smilax*, species *rotundifolia*.

J. J. LEVISON

See also SMILAX.

GREENE, GRAHAM (1904-), a British novelist, won fame both for stories of adventure and serious novels. He called such works as *The Man Within* (1929), a novel about smugglers, "entertainments." His more serious works, such as *The Power and the Glory*, or *The Labyrinthine Ways* (1940), *The Heart of the Matter* (1948), and *The Quiet American* (1955), dealt with acute problems of conscience. He also wrote dramas, including *The Living Room* (1953) and *The Potting Shed* (1957). Greene was born in Berkhamstead. HARRY T. MOORE

GREENE, NATHANAEAL (1742-1786), an American Revolutionary War general, became noted for his campaigns against the British in North and South Carolina between 1780 and 1782. Many historians rank him second only to George Washington as a military leader.

Greene was born to a Quaker family at Potowomut (Warwick), R.I. Because he was interested in military affairs, the Quaker church, which does not believe in warfare, expelled him. He served in the Rhode Island legislature from 1770 to 1772, and in 1775. In October, 1774, when trouble with Great Britain threatened, he organized a militia company called the Kentish Guards. Because he had a stiff knee, his men would not let him act as an officer, and he served in the ranks. After the battle of Lexington, the Kentish Guards set out to aid the patriots. The governor of Rhode Island was loyal to the British and recalled them. But Greene and three other men went to Boston. He became a brigadier general in the Continental Army, and took part in the siege of Boston. In 1776, he became a major general, and

then commanded the army of occupation in Boston.

Greene fought in the battles of Trenton, Brandywine, and Germantown, and he was with Washington at Valley Forge. In 1778, he became quartermaster general, but he resigned in 1780 because of an investigation by politicians of the quartermaster department.

In December, 1780, Greene replaced General Horatio Gates, whose army had been badly beaten at Camden, S.C. By skillful preparation and a series of brilliant maneuvers, Greene pushed the British back into Charleston and Savannah by the end of December, 1781. Georgia gave him a plantation near Savannah, and he went there to live in 1785. Rhode Island placed a statue of Greene in Statuary Hall in 1869.

JOHN R. ALDEN

GREENFIELD VILLAGE is a group of 92 historical buildings and landmarks collected by Henry Ford and restored to their original condition. It is located in Dearborn, Mich. Included are 14 craft shops; the house in which Stephen Foster was born; and Thomas A. Edison's laboratory. Adjacent is the Henry Ford Museum, which contains exhibits in fine arts, transportation, and other fields. The Edison Institute School offers courses through sixth grade.

FRANKLIN M. RECK

See also EDISON, THOMAS A. (picture, The Menlo Park Laboratory); MICHIGAN (Interesting Places to Visit).

GREENGLASS, DAVID. See ROSENBERG, ETHEL GREENGLASS AND JULIUS.

GREENHOUSE is a glass building in which plants can be grown throughout the year. Artificial heat supplies warmth in winter, and ventilation cools the greenhouse in summer. The glass may be shaded for plants that cannot thrive in full sunlight. Water controls allow the grower to raise desert plants as well as plants from tropical rain forests. The plants may be grown in beds on the ground or on benches.

Persons who grow plants as a hobby often have small greenhouses. Commercial structures are usually long, rather narrow buildings. Their glass roofs are peaked to allow a maximum amount of light to enter. They also have hinged sections that open for ventilation. The glass, or a plastic substitute, rests on a framework of wood, iron, or aluminum. Pipes for water and heating encircle the building.

HENRY T. NORTEN

See also HOTBED.

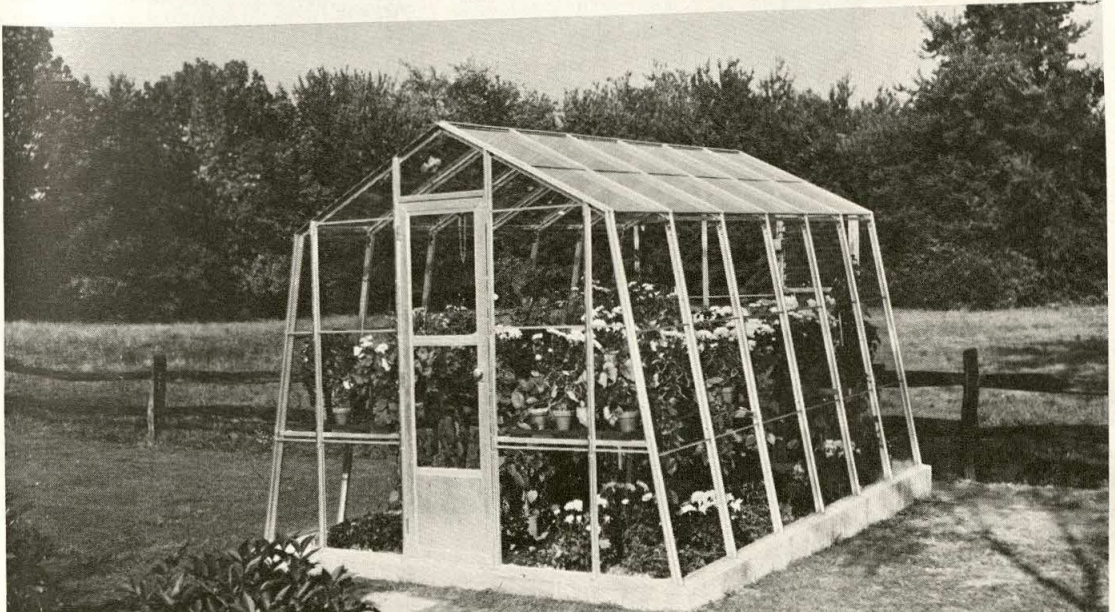


Nathanael Greene, right, led American troops in many major Revolutionary War battles. On his way to take command of troops in the South in 1781, a patriotic hotelkeeper gave Greene her life savings to help fight the war, above.

Chicago Historical Society; Brown Bros.

A Small Greenhouse makes it possible for the home gardener to grow flowers and vegetables the year round. It furnishes proper humidity and heat, and protects plants in bad weather.

Lord & Burnham



GREENLAND



Tanks, Black Star

Greenland Costumes for holidays include beaded collars, and embroidered trousers and boots for women.

GREENLAND is the world's largest island. Its land area is mostly within the Arctic Circle. Northwestern Greenland lies 10 miles east of the northernmost point of Canada. Greenland is a county of Denmark, although it is separated from Denmark by 1,300 miles of ocean. Godthaab is Greenland's capital and largest town.

Greenland is about fifty times as large as Denmark, but only about 24,000 people live on the island. This is about half as many people as live in Las Vegas, Nev. The Norse explorers who discovered the island named it for its green coasts, in order to attract settlers. However, only the outermost rim of Greenland is ever green. This is where most of the people live. About 85 per cent of the country's surface is covered by ice.

Greenland is important because of its location. Weather forecasters stationed on the island can predict storms on the North Atlantic. Greenland also has important United States military bases that are part of the defense system of the North Atlantic.

The Land and Its Resources

Location, Size, and Surface Features. Davis Strait and Baffin Bay are the main bodies of water that separate Greenland from the rest of North America. The Arctic Ocean lies north of Greenland. The *Map* shows that the island is bounded on the east by the Greenland Sea, Denmark Strait, and the Atlantic Ocean. Greenland covers 840,000 square miles.

Most of Greenland lies within the Arctic Circle. Cape Morris Jesup, 448 miles from the North Pole, is the world's northernmost land. Greenland consists of an inland plateau surrounded by a fringe of mountains. Most of these coastal mountains rise sharply out of the

FACTS IN BRIEF

Form of Government: A county of Denmark.

Capital: Godthaab.

Head of State: National commissioner, appointed by the Danish government.

Area: 840,000 square miles. *Greatest distance:* (north-south) 1,660 miles; (east-west) 750 miles.

Elevation: *Highest,* Mount Gunnbjørn, 12,139 feet. *Lowest,* sea level.

Population: 24,015. *Density,* about .03 persons to the square mile.

Chief Products: *Agriculture,* sheep, vegetables. *Fishing Industry,* cod, herring. *Mining,* cryolite, lead.





Neat Wooden Houses of Godthaab, Greenland's capital and largest town, cluster at the foot of a rocky ridge.

Greenland is about one fourth the size of the United States.



sea to heights of 4,000 to 8,000 feet. The highest point on the island is 12,139-foot Mount Gunnbjørn in the southeast. Long, deep *fjords*, or narrow sea inlets, cut into the coast line (see *FIORD*).

Only 132,000 square miles of land in Greenland, along the coast, are free of ice. This area is about eight times the size of Denmark. An icecap up to 10,000 feet thick covers the rest of the island. Seismographic measurements determined the thickness of this icecap. The average height of the interior plateau is 4,500 feet above sea level. Its vast expanses of dazzling snow and ice are broken by a few ice-free rocky Peaks. The interior has several small lakes, and rivers.

Natural Resources. The long hours of summer sunshine make it possible for bright flowers and green foliage to grow in the thin, stony soil along the coast. Southern Greenland has a small number of scrub willow, alder, birch, and rowan trees. Lichen and moss cover the ground in most of the ice-free places.

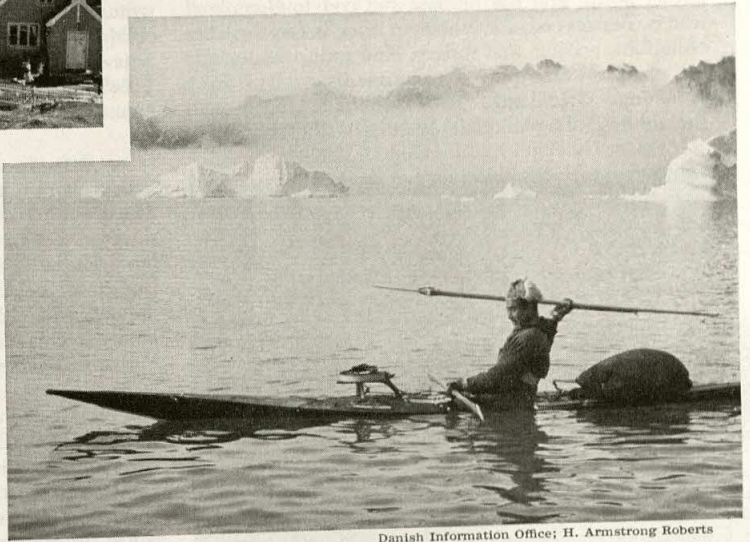
Reindeer, foxes, arctic hares, and polar bears are the chief animals of Greenland. Birds include the ptarmigan and the sea eagle. The cod is the most common fish.

The island's mineral resources are largely unknown. But Greenland is the world's largest source of cryolite, one of the minerals used in making glass and aluminum. A lead and zinc mine was opened in 1956. Disko Island, off the west coast, has a poor grade of coal.

Climate. Greenland's cold climate is gradually growing warmer. In northern Greenland, the sun shines constantly for four months each summer. It does not shine on Greenland at all during four winter months. January temperatures in Greenland range from -30°F . in the north to 20°F . in the south. July temperatures in Greenland average 40°F . Less than 10 inches of rain falls annually in most of Greenland. However, from 40 to 60 inches falls on the southern tip.

The People and Their Work

The People. About 1,400 of the people are Europeans, most of whom are Danes engaged in weather service, commerce, teaching, and administration. The rest are Greenlanders. Greenlanders are of Eskimo



Danish Information Office; H. Armstrong Roberts

Greenland's Fishermen Harpoon Fish from Sealskin-Covered Kayaks.

origin, but most of them also have Danish blood. More than 90 out of every 100 persons live along the west coast, where the best land is located. Greenlandic is the official language of the island, but most of the people also speak Danish. Greenlandic is one of the most important Eskimo languages, and resembles Eskimo dialects spoken in North America.

Way of Life. The people are hospitable and social. Most Greenlanders used to be wandering hunters who lived in widely-scattered huts made of stone and dirt. Today, nearly all the people live in small towns and have wooden homes. Most of the wood for these homes must be imported because the island has so few trees. The typical modern Greenland house has a living room and kitchen downstairs, and one or two bedrooms upstairs. Fish is an important part of the people's diet, but more and more fresh and canned foods are being imported to vary the diet.

Cloth dresses and suits imported from Denmark have largely replaced clothing made of skin, except in the far north. The *anorak*, a hooded jacket, still is popular for outdoor wear. Women wear traditional Greenland costumes for holiday events. These costumes include beaded collars, colorful shirts, and embroidered trousers and boots.

Towns. Most of the settlements in Greenland lie along the southwestern coast. The largest and most important towns include the capital, Godthaab (pop. 1,389); Julianehaab (pop. 1,202); and Holsteinbo (pop. 1,103). Other towns, together with their populations, are Sukkertoppen (821); Egedesminde (670);

GREENLAND

Kutdligssat (616); Jacobshavn (593); Godhavn (457); Frederikshaab (433); Nanortalik (406); and Narssak (399). See GODHAVN; GODTHAAB.

Fisheries. Until recently, many Greenlanders made their living by hunting seals. The seals furnished food, fuel, clothing, and bones for hunting weapons. The gradual change of climate has driven most seals farther north, and has brought the cod to Greenland waters. Besides cod, the fishermen bring in large catches of halibut, herring, and shrimp. New industries include fish canneries and quick-freezing plants.

Mining. Greenland's most profitable industry is the mining of cryolite at Ivigtut in the southwest.



Tall-Masted Boats used for deep-water fishing often are paid for by taking up a collection in a Greenland village.

The island also has deposits of uranium, copper, lead, and graphite.

Agriculture is limited to small crops of wheat, potatoes, and other vegetables. Thousands of sheep graze in southern Greenland.

Exports and Imports. Trade is mostly with Denmark. Cryolite is the principal export. Other exports include hides and furs, whale and seal blubber, salted codfish, and other fish products. Greenland imports most of its foods, textiles, machinery, iron, and coal.

Transportation and Communication. Most Greenlanders live along the coasts, and often rely on water transportation. However, ships seldom sail north of the port of Upernavik on the west coast. Motorboats and cutters are common. Kayaks, light canoes made of

animal skins, also are used (see KAYAK). Greenland has a few miles of roads, chiefly in the towns. The people use dog sleds for travel in the ice-covered interior. The United States maintains three air bases on the island. Commercial airliners also serve Greenland. The island has telephone and radio service.

Social and Cultural Achievements

Education. Everyone in Greenland can read and write. Education is free, and the law requires all children between the ages of seven and fourteen to attend school. Godthaab has a college.

Religion. Greenland has complete religious freedom. Most of the people are members of the Lutheran Church.

Government

Greenland is a county of the Kingdom of Denmark. The Danish government appoints a national commissioner, or governor. He is the highest official in Greenland. He is chairman of the national council, which is elected by the Greenlanders. The council must approve all legislation dealing specifically with Greenland. Greenlanders elect two members of the Danish Parliament. They also elect local officials.

History

Early Days. Eric the Red, a Norse chieftain, discovered Greenland about A.D. 982. The Norsemen founded settlements on the island about three years later. Leif, Eric's son, is believed to have discovered North America in the year 1000 (see VINLAND). Greenland became a possession of Norway in 1261. Denmark, Norway, and Sweden were united under the Danes in 1397. At that time, Greenland became a Danish possession. By the end of the 1400's, the harsh climate and the native Eskimos had destroyed the Norse settlements.

Danish Colonization began in 1721, when Hans Egede, a Lutheran missionary, set up a mission on the west coast. The Danes converted the Eskimos to Christianity. When the union of Denmark and Norway ended in 1814, Greenland remained a Danish colony.

Danish expeditions in the 1800's and 1900's added greatly to the knowledge of Greenland's geography and resources. Norway claimed 21,000 square miles of land on the east coast in 1931. The Danes disputed this claim, and two years later they were upheld by the World Court.

Modern Times. German forces landed in Greenland in 1940 and set up several observation posts there. United States forces landed in Greenland in 1941. They destroyed the German posts and built military bases and weather stations for Allied use during World War II.

In 1951, the United States and Denmark signed an agreement for the joint defense of Greenland against invasion. A new Danish constitution, adopted in 1953, changed Greenland's status from a colony to a county of Denmark. In the early 1960's, the first *Ballistic Missile Early Warning System* radar post was finished at Thule. It protects North America and western Europe against surprise missile attacks.

JENS NYHOLM

Related Articles in WORLD BOOK include:

Arctic	Eric the Red	Godhavn	Krone
Baffin Bay	Ericson, Leif	Godthaab	Thule
Cape York	Eskimo	Ice Cap	Viking
Cryolite	Fiord	Kayak	

GREENLAND RIGHT WHALE. See **ANIMAL** (color picture, Arctic Lands and Seas); **WHALE** (diagram).

GREENLET. See **VIREO**.

GREENOUGH, GREEN oh, HORATIO (1805-1852), an American sculptor, made the statue of George Washington that stands in the Smithsonian Institution in Washington, D.C. One of his important early works was another statue of Washington, modeled from Gilbert Stuart's famous portrait. Greenough also made busts of such men as John Adams and John Quincy Adams, Henry Clay, John Jacob Astor, and John Marshall. He was born in Boston, and was graduated from Harvard College. He also studied in Rome and Florence, Italy. JEAN LIPMAN

GREENSAND. See **GLAUCONITE**.

GREENSBORO, N.C. (pop. 119,574; alt. 840 ft.), is an industrial and educational center on the hilly Piedmont plateau, about 85 miles northwest of Raleigh (see **NORTH CAROLINA** [color map]). Textile factories in Greensboro manufacture denim, flannel, khaki, and rayon cloth. Other products include nylon stockings, chemicals, medicines, cosmetics, electrical equipment, tobacco, work clothing, and iron, steel, and wood products. The city is a large insurance center.

Greensboro is the home of the Woman's College of the University of North Carolina, Agricultural and Technical College of North Carolina, Greensboro College, and Bennett College. Near the city are the Oak Ridge Military Institute and Guilford College.

Greensboro was chartered in 1808. It was named for Major General Nathaniel Greene, commander of the Continental army at the battle of Guilford Courthouse (March, 1781). The city is the seat of Guilford County, and has a council-manager government. HUGH T. LEPLER

See also **GREENE, NATHANIEL**.

GREENSBORO COLLEGE is a liberal arts coeducational college at Greensboro, N.C. It is sponsored by the Methodist Church. The college has a school of music as well as a school of arts and science. Students may study for the degree of Bachelor of Arts or Bachelor of Music. Greensboro College was founded in 1838. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GREENVILLE, Miss. (pop. 41,502; alt. 125 ft.), is an important port and center for marketing and processing cotton. It lies along the Mississippi River on the Mississippi Alluvial Plain (see **MISSISSIPPI** [map]).

Factories in Greenville make carpeting, chemicals, cottonseed oil, insulating board, and glass, wood, stone, and clay products. The city also has cotton textile mills. It is the home of Greenville Air Force Base, which houses tactical air force units.

Settlers first arrived in 1828. Greenville was incorporated in 1870. In 1927, a flood submerged the town for 70 days. The U.S. Army Corps of Engineers changed the course of the Mississippi River in 1935 to prevent future floods. Greenville has a council-manager form of government. CHARLOTTE CAPERS

GREENVILLE, S.C. (pop. 66,188; alt. 966 ft.), is a textile center in the state's northwest corner (see **SOUTH CAROLINA** [map]). The Reedy River runs through the heart of the city. Greenville's many textile factories manufacture clothing, sewing thread, and bedspreads. Other factories make bricks, chemicals, fertilizers, and paints, and pack meat products. This area was settled in 1797 as Pleasantburg. The name was

changed to Greenville, and it became a city in 1831. It is the site of the Southern Textile Exposition, which is held every two years. Greenville is a summer resort area, and is the home of Furman University. It has a council-manager form of government. JULIAN J. PEFFY

GREENVILLE COLLEGE, located at Greenville, Ill., is a coeducational college of arts and science. It is sponsored by the Free Methodist Church. The college offers courses in liberal arts, business, music, religion, and pre-engineering. Greenville grants A.B., B.S., and Th.B. degrees. It was founded in 1892. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GREENWAY, JOHN CAMPBELL (1872-1926), an American mining engineer and soldier, led in the development of mining and transportation in Arizona. He went to Arizona in 1910, and became an executive in a mining company, a lead company, and a railroad. Greenway served as a Roughrider during the Spanish-American War and as a lieutenant colonel in World War I (see **ROUGHRIDERS**). Arizona placed his statue in Statuary Hall in the Capitol building in Washington, D.C. He was born at Huntsville, Ala. J. R. GRAP

GREENWICH, Conn. (pop. 53,793; alt. 30 ft.), lies on Long Island Sound, 28 miles from New York City. For location, see **CONNECTICUT** (color map).

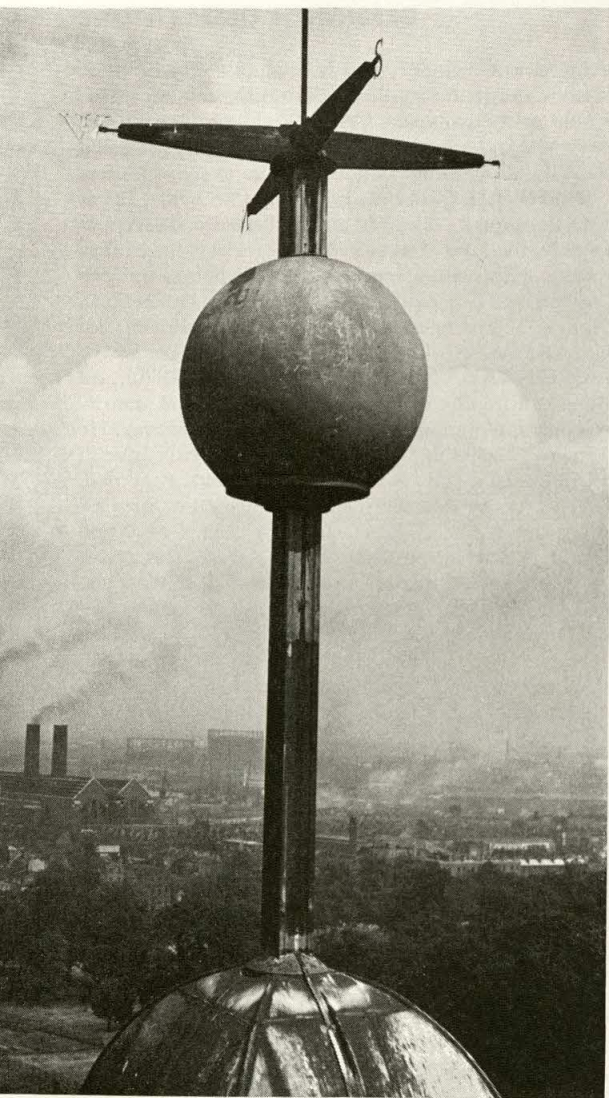
Greenwich is sometimes called *The Gateway to New England*, because it is the first Connecticut city on the main automobile routes leading from New York City to New England. Many of its people work in New York City. About 6,000 people work in Greenwich factories. Products include boats, canvas covers, electric generators, industrial felt, machine tools, plastic products, precision instruments, pumps, sails, ship engines, and vacuum cleaners. Printing and publishing are also important industries. The Audubon Nature Center, a wildlife sanctuary, opened in Greenwich in 1943.

Representatives of the New Haven colony bought the Greenwich area from the Siwanog Indians for 25 cents in 1640. Greenwich received its charter as a borough in 1854. It has a representative town meeting form of government. Representatives of each town district form the legislative body, which is headed by a board of selectmen. ALBERT E. VAN DUSEN

GREENWICH MERIDIAN. See **GREENWICH OBSERVATORY**.

GREENWICH OBSERVATORY, GRIN ihj, is the oldest observatory in constant use. The institution formerly stood on top of a small hill overlooking the Thames River in London, England. Founded by Charles II in 1675, the observatory was used to prepare accurate tables of the positions of the moon and fixed stars to help ship navigators determine locations at sea. In 1953-1954, it was moved to Herstmonceux Castle in Sussex to avoid interference from London lights.

The director of the Greenwich Observatory is given the title Astronomer Royal by the British government and is chosen from among the best astronomers in Great Britain. Some of the most famous British scientists have held this position. One of them, John Flamsteed (Astronomer Royal from 1675 to 1719), made the accurate observations of the moon which helped Newton formulate the laws of gravitation. Another, Edmund Halley (1720 to 1742), predicted the return of the comet which



Courtesy Life Magazine © Time, Inc.

The Time Ball of the Greenwich Observatory in London signals the correct time as determined by astronomers. By tradition, the ball is dropped every day at 1 p.m. Time balls were first used in the days before observatories transmitted time signals by radio and other modern communication methods.

was later named Halley's Comet after him. James Bradley (1742 to 1762) discovered the aberration of light. Frank Dyson (1910 to 1933), with A. S. Eddington, verified Einstein's theory of relativity by showing that the rays of distant stars are slightly bent when they pass close to the sun. The Greenwich Observatory conducts practical investigations as well as pure research.

Prime Meridian. In 1884, an international conference of astronomers in Washington, D.C., decided that the Greenwich Observatory should mark the prime meridian of the earth. Maps of most countries were changed to show the longitude marked east or west of Greenwich, which was located on 0° longitude. The earth was divided into 24 time zones, 15° longitude wide. When the clock at Greenwich shows noon, Greenwich mean

time, it is 2 o'clock in the afternoon 30° east of Greenwich, Eastern European standard time. See **MERIDIAN**.

Although the Greenwich Observatory was moved southeast to Sussex, 0° longitude remains at its original location. The British astronomers now subtract about a minute and a quarter from the time observed at Sussex to determine Greenwich time. **OTTO STRUVE**

See also **OBSERVATORY**.

GREENWICH VILLAGE. See **NEW YORK CITY** (Interesting Places to Visit).

GREETING. See **ADDRESS, FORM OF; INTRODUCTIONS; SALUTE**.

GREETING CARDS mark special occasions or provide friendly greetings to persons receiving them. The first modern greeting card was a Christmas card made in London in the 1840's. Historians believe that Joseph Calcutt Horsley, a Royal Academy artist, created it for Henry Cole. Cole had 1,000 copies *lithographed*, or reproduced, and sent them to his friends. Since that time, the sending of greeting cards, such as Valentine's Day cards, has become an important social custom. See also **CHRISTMAS; VALENTINE'S DAY**.

JOHN J. OAKSON

GREGG, JOHN ROBERT (1867-1948), invented the Gregg system of shorthand, in which lines and curves represent letters and syllables. Perfected in 1888, the Gregg system is used throughout the world and has been adapted to 11 languages.

Gregg founded a school in Chicago to teach his system and other business subjects. He directed a firm that published his books and other texts on business. He also edited two business magazines. Gregg was born in Ireland. He came to America in 1893.

GALEN SAYLOR

See also **SHORTHAND**.

GREGG, WILLIAM. See **SOUTH CAROLINA** (Famous South Carolinians).

GREGORIAN CALENDAR, *greh GOH rih un*, is the calendar that is used in almost all the world today. All modern business uses its dates. It was made up by Pope Gregory XIII in 1582 to correct the Julian calendar, which Julius Caesar worked out in 46 B.C.

The Julian calendar year was 11 minutes and 14 seconds longer than the solar year. By A.D. 1580, this difference had accumulated to 10 days. Pope Gregory dropped 10 days from October to make the calendar year correspond more closely to the solar year. He also decreed that each fourth year would be a *leap year*, when February would have an extra day. Years marking the century would not be leap years unless divisible by 400. For example, 1600 was a leap year, but 1700, 1800, and 1900 were not. At present, the average Gregorian year is about 26.3 seconds longer than the solar year. By the year 4316, it will have gained one day on the sun.

DONALD H. MENZEL

See also **CALENDAR**.

GREGORIAN CHANT. See **MUSIC** (The Middle Ages).

GREGORY was the name of 16 popes of the Roman Catholic Church. Gregory I and Gregory VII were among the most important of all popes. The dates of their reigns were:

Gregory I, Saint	(590-604)
Gregory II, Saint	(715-731)
Gregory III, Saint	(731-741)
Gregory IV	(827-844)
Gregory V	(996-999)
Gregory VI	(1045-1046)

Gregory VII, Saint	(1073-1085)
Gregory VIII	(1187)
Gregory IX	(1227-1241)
Gregory X, Blessed	(1271-1276)
Gregory XI	(1370-1378)
Gregory XII	(1406-1415)
Gregory XIII	(1572-1585)
Gregory XIV	(1590-1591)
Gregory XV	(1621-1623)
Gregory XVI	(1831-1846)

Saint Gregory I, called **THE GREAT** (?-604), was born of noble family. He became vitally interested in religious matters. When he came into possession of his family's fortune, he devoted it to the founding of monasteries, and took the vows of a monk.

Gregory was especially interested in missionary activity. But he was highly esteemed in Rome, and Pope Benedict I would not let him leave. Under Pope Pelagius II, he served as legate to Constantinople. When Pelagius died in 590, Gregory was chosen pope despite his protests. His threat to negotiate a separate peace with the Lombards prompted the exarch of the Byzantine Emperor to arrange a treaty of peace between the Lombards and the Byzantine Empire.

Gregory sent Saint Augustine and a band of Benedictine monks to convert England. He also established missions in Sicily, Sardinia, and Lombardy. He enforced the prohibition of marriage among the clergy, reorganized papal finances, and secured recognition of his authority throughout the Christian world. Gregory introduced the style of singing in churches known as "the Gregorian chant" (see **MUSIC** [The Middle Ages]).

Saint Gregory VII (?-1085) was one of the most important popes in the Middle Ages. Almost every move of his reign was made with the aim of freeing the church from the control of kings and princes. As a Benedictine monk, Hildebrand—as he was called before his election as pope—was the spiritual leader of the Cluniac reform movement. He gained considerable experience as adviser to five popes. In 1073, he was chosen unanimously as pope.

One of Gregory's first acts was to enforce everywhere the prohibition of clerical marriage. In this he met with great opposition. His greatest struggle was against lay investiture, whereby bishops and other holders of church offices were selected by laymen. The Holy Roman Emperor Henry IV maintained that because church officials received fiefs from him and performed secular functions, he had the right to select them and officially install them in office.

When Henry refused to abide by Gregory's decrees on lay investiture, the pope excommunicated him and released his vassals from their allegiance to him. The German vassals seized the opportunity to revolt, and Henry was forced to surrender. He went to Canossa, where Gregory was staying, and there he made his submission. But as soon as he put down his rebellious vassals, Henry returned to Rome to overthrow Gregory. The pope fled to Salerno, where he died in exile. See **HENRY (IV)** of Germany.

Gregory XIII (1502-1585) was elected pope in 1572. He had served previously as jurist at the Council of Trent, as legate to Spain, and as cardinal. He is best remembered as founder of the system of seminaries to train Roman Catholic priests, and as father of the

Gregorian calendar, which is still in use today (see **GREGORIAN CALENDAR**). **THOMAS P. NEILL** and **FULTON J. SHEEN**

GREGORY, LADY AUGUSTA (1852-1932), was an Irish playwright and folklorist. Her most famous plays include *Spreading the News* and *The Rising of the Moon*, both published in 1909 in *Seven Short Plays*. She also contributed to contemporary drama by helping found the Abbey Theatre in Dublin (see **DRAMA** [The Irish Revival]). Her most important book of folklore was *Cuchulain of Muirtheimne* (1902). Lady Gregory was born **AUGUSTA PERSSE** in County Galway. She married **Sir William Gregory** in 1881.

LEO HUGHES

GREMLIN is the name that aviators give to imaginary pixies who make mischief in airplanes. Gremlins supposedly wear tight coats, pointed shoes, and sometimes spats. No one has ever found a good gremlin. Gremlins clog gas pipes, jam engines and guns, and cause trouble in general. A young gremlin is called a *widget*, and a female gremlin is a *ffinella*.

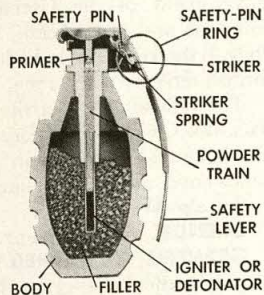
Pilots of the British Royal Air Force invented the word *gremlin*. British and American airmen used the word widely during World War II. They blamed all unexplained troubles on gremlins.

ARTHUR M. SELVI

GRENADA. See **WINDWARD ISLANDS**.

GRENADE, *grih NAYD*, is a small explosive bomb. The first grenades looked like pomegranates. *Fragmentation* grenades have cast-iron or steel containers that shatter into many pieces when they explode. *Chemical*

Fragmentation Grenades, right, split into dozens of deadly chunks of flying metal when they explode. Learning how to throw grenades is an important part of military training. A paratrooper, below, practices an overhand delivery. Grenades are used to destroy machine-gun nests and positions behind hills.



U.S. Signal Corps



GRENADIER

grenades are steel containers filled with white phosphorus. Grenades may be thrown by hand, and they may be fired from a rifle, or hurled by a spring-operated catapult.

Grenades were used in the 1400's. In the 1600's and 1700's specially trained men called *grenadiers* used them (see GRENADIER). In World Wars I and II, all armies had grenades.

MELVIN M. JOHNSON, JR.

See also BOMB; CATAPULT; FRAGMENTATION.

GRENADIER, *grehn uh DEER*, was a French soldier in the 1700's, trained to throw hand grenades. Grenadiers were selected for their strength, nerve, and initiative. They wore distinctive, colorful uniforms. Gradually, other European armies created grenadier units. They took the best soldiers from other units to organize these elite battalions. Improvements in small arms weapons made grenade bowling suicidal by 1800. But armies still maintained grenadier units as key reserves. Some European armies still have regiments that carry grenadier titles. For example, the British Grenadier Guards, which traces its title to Waterloo in 1815, helps guard Buckingham Palace in London.

THOMAS E. GRIESS

GRENADINES make up a chain of small and mostly uninhabited islands in the West Indies. The group includes about 600 islands. They stretch across the Caribbean Sea for 60 miles, between St. Vincent and Grenada. About 7,200 persons live on the islands. Most of them raise cotton or cattle, or work as seamen. The government of the Grenadines is divided between Grenada and St. Vincent, but the group does not belong to the West Indies Federation. The group has been British territory since 1763.

The official name of the Grenadines is GRENADINE ISLANDS. Carriacou, famous for its sea-island cotton, is the largest island, with an area of 6,913 acres. The islands cover about 30 square miles.

W. L. BURN

See also WEST INDIES.

GRENDAL. See BEOWULF.

GRENELL, SIR WILFRED THOMASON (1865-1940), a British medical missionary, became known as "Grenfell of Labrador." He helped establish hospitals, orphanages, nursing stations, schools, and cooperative stores in the cold, bleak regions near the Arctic Circle.

Grenfell was born in Cheshire, England. He studied medicine at Oxford University and the London Hospital. He entered the medical service of the Royal National Mission to Deep Sea Fishermen in 1889, and sailed on fishing cruises from the Bay of Biscay to Iceland. In 1892, Grenfell was sent with hospital supplies to explore living conditions in Labrador and Newfoundland. He found much illness, especially beriberi and tuberculosis, and no doctors. He treated more than 900 patients within three months. For the next 40 years, Grenfell served the people as surgeon, scientist, sailor, and explorer. His program of

Sir Wilfred Grenfell

BROWN BROS.



mercy continues to operate through the International Grenfell Association.

HENRY J. L. MARRIOTT

GREVILLE, GEORGE. See REVOLUTIONARY WAR IN AMERICA (The Navigation Acts).

GREVILLE, SIR RICHARD (1541-1591), an English naval commander, led Sir Walter Raleigh's first expedition to America. He helped establish the first English colony in North America, on Roanoke Island, in 1585. This settlement was abandoned, and the surviving colonists returned with Sir Francis Drake in 1586 (see DRAKE, SIR FRANCIS; LOST COLONY; RALEIGH, SIR WALTER).

Greville also commanded a squadron against the Spanish Armada in 1588 (see ARMADA). In 1591, he took part in an expedition under Lord Thomas Howard to intercept a Spanish treasure fleet near the Azores Islands. A large Spanish fleet surprised the expedition off the island of Flores. Howard refused to fight against such odds, and sailed away. Greville stayed and was killed in the fight. His brave effort made him famous as an outstanding example of the fighting spirit of great Elizabethan naval heroes.

Greville was born near Bideford, Devonshire. He was knighted in 1571.

JAMES G. ALLEN

GRESHAM'S LAW states the principle that "bad money tends to drive good money out of circulation." The law is named after Sir Thomas Gresham, founder of the Royal Exchange in London. But he was not the first to notice the obvious fact that if a man has two gold coins of the same face value, and one of them is heavier, he will probably save the heavy one and spend the light one.

As early as the 1200's, dishonest dealers shaved the edges of gold coins. Those who received these lightweight coins would usually pass them along as soon as possible, and keep the full-weight coins as long as they could. Gresham stated this principle as follows:

Where by legal enactment a government assigns the same nominal value to two or more forms of circulatory medium whose intrinsic values differ, payments will always, as far as possible, be made in that medium of which the cost of production is least, the more valuable medium tending to disappear from circulation.

In 1896, American owners of gold coins hoarded them because there was a chance that silver coins might be legally made equal in value to gold coins. During the period just after World War I, so much paper money was used in Europe that metal coins disappeared.

See also BIMETALLISM; MONEY (Modern Money Systems).

GRETNA GREEN is a village in Scotland noted for the runaway marriages which were formerly performed there. It lies in Dumfriesshire, just over the English border. Couples in England who wanted a quick marriage eloped to Gretna Green. There they had only to make their promises to a clergyman in the presence of witnesses. The fee was often demanded during the ceremony to insure payment before angry parents arrived. Gretna Green had four places where marriages were held. An act of parliament abolished the practice in 1856. Marriages in Scotland were made illegal unless one of the parties had lived there for at least 21 days. Any town to which couples go to be married in haste is sometimes called Gretna Green.

CLARENCE D. THORPE

GRETTIR THE STRONG. See SAGA.

GREUZE, gruz, JEAN BAPTISTE (1725-1805), was an amazingly successful French painter of the 1700's. His paintings of young girls and his moral scenes of family virtue were both popular, because the taste of his time delighted both in hints of moral weakness and in dramatic examples of simple propriety. Some of his most popular paintings were *The Broken Pitcher*, *The Village Bride*, and *The Father's Curse*.

Greuze was born in Tournus. After some training in Lyon, he went to Paris, where he attracted many patrons. He lost both his money and his popularity during the French Revolution.

JOSEPH C. SLOANE

GREVY, JULES. See FRANCE (The Third Republic).

GREW, JOSEPH CLARK (1880-), served as the United States Ambassador to Japan during the years before the 1941 Japanese attack on Pearl Harbor. A shrewd diplomat, he predicted the attack and warned the U.S. Department of State that economic pressure upon Japan would lead to war. Grew retired in 1945. He was born in Boston, and was graduated from Harvard University.

HARVEY WISH

GREY, EARL (1851-1917), ALBERT HENRY GEORGE GREY, was Governor-General of Canada from 1904 to 1911. He was so popular that the Canadian government asked that his term of office be extended. His administration was eventful. Grey helped maintain and extend British imperialism in Canada. He dealt skillfully with French Canadians, as well as with the English Canadians.

Grey was born at Howick, Northumberland, England. He was a member of the House of Commons and administrator of Rhodesia. One of the early members of the Liberal party, he supported social reform.

LUCIEN BRAULT
GREY, EDWARD (1862-1933), VISCOUNT GREY OF



BROWN BROS.

Earl Grey

FALLODON, was a British diplomat and statesman. As foreign minister from 1905 to 1916, Grey led efforts to avoid a European war. He consolidated the Triple Entente, which allied Great Britain with France and Russia.

At the London peace conference in 1912, Grey led the discussion of Balkan problems, and was largely responsible for the decision to form the country of Albania. After World War I, he actively supported the League of Nations. He was born in Northumberland, and studied at Oxford University.

ANDRÉ MAUROIS

GREY, LADY JANE (1537-1554), became known as "the nine days' queen" of England. She was the great-granddaughter of Henry VII of England, and daughter of Henry Grey, Duke of Suffolk. She studied languages and was considered an unusually accomplished girl. At the age of 16, she married Lord Guildford Dudley, son of the Duke of Northumberland.

The Duke of Northumberland persuaded King Edward VI to give Lady Jane the right to succeed him as ruler. Edward feared that if the crown should descend to his sister Mary, who was a Catholic, England would no longer be a Protestant nation. Edward died on July



Chicago Historical Society

English Courtiers Offered the English Crown to Lady Jane Grey on the death of Edward VI. She declined the honor at first, but was persuaded to accept. She reigned for only nine days.

6, 1553. His death was kept secret for several days. Lady Jane was proclaimed queen on July 10.

But in less than two weeks after the proclamation, Mary's claims to the throne were recognized. Lady Jane was imprisoned in the Tower of London, and was arraigned for high treason on Nov. 14, 1553. Lady Jane and her husband were beheaded on Feb. 12, 1554. She was born at Broadgate, Leicestershire.

W. M. SOUTHGATE

See also MARY (I); TOWER OF LONDON.

GREY, ZANE (1875-1939), wrote popular stories about the American West. He wrote more than 60 books, which sold millions of copies. The best-known of his 54 novels were *The Spirit of the Border* (1905), *The Last of the Plainsmen* (1908), *Riders of the Purple Sage* (1912), and *The Lone Star Ranger* (1915). He also wrote books on game fishing. Grey was born in Zanesville, Ohio, and was graduated from the University of Pennsylvania.

FREDERICK J. HOFFMAN

GREYHOUND is the fastest of dogs. All varieties have a streamlined body with a pointed muzzle, arched back, slender wasp waist, and long, powerful legs. An adult greyhound weighs 60 to 70 pounds. Its hair is short, and is often tan, brindle, white, bluish, or spotted.

The greyhound hunts by sight instead of scent, because it is fast enough to keep the game in view. It has been used to hunt rabbits, especially on the Kansas plains. Greyhound racing has become an organized sport. The greyhound originated in Egypt, in 4000-3500 B.C. There are different types throughout the world. Other members of the greyhound family are the Irish wolfhound, Scottish deerhound, Italian greyhound, saluki, Afghan hound, whippet, and borzoi. Greyhounds are outdoor dogs.

HENRY P. DAVIS

See also DOG (color picture, Hounds).

GREYHOUND BUS LINES. See Bus (Leading Bus Companies).

GRIBBLE

GRIBBLE. See WOOD LOUSE.

GRIBOEDOV, ALEXANDER. See RUSSIAN LITERATURE (The 1700's).

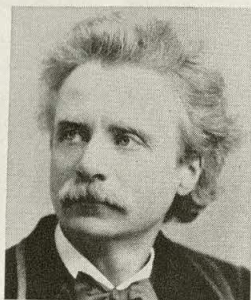
GRID. See BATTERY (The Edison Cell); ELECTRONICS (Triode).

GRID, GEOGRAPHIC. See MAP (Geographic Grids).

GRIDIRON. See FOOTBALL (The Field).

GRIEG, greeg, EDVARD (1843-1907), was a Norwegian composer, pianist, conductor, and teacher. He was the first Scandinavian to compose nationalistic music, drawing many of his themes from Norwegian folk songs and dances.

Grieg's *Concerto in A minor* for piano and orchestra (1868) is often considered his most ambitious work. He also wrote lyrical pieces for the piano, including *Album Leaves* (1864), *Norwegian Dances and Folk Songs* (1870), and *Moods* (1902). He composed such beautiful songs as "A Swan," "Departed," and "I Love Thee."



Brown Bros.

Edvard Grieg

In 1874, Henrik Ibsen, a Norwegian playwright, asked Grieg to compose music for his play *Peer Gynt*, based on the life of a character in Norse folklore. At the same time, the Norwegian government granted Grieg an allowance for life. This made it possible for Grieg to devote himself to composition. Grieg developed two orchestral suites from the music for the play. Many selections became popular, including "Morning," "Ase's Death," "Anitra's Dance," and "In the Hall of the Mountain King."

Grieg also wrote chamber music. He composed three violin sonatas, a sonata for cello, and *String Quartet in G minor* (1877-1878).

Grieg was born on June 15, 1843, in Bergen. When he was 15, he entered the Leipzig Conservatory in Germany. Upon returning to Norway, he discovered his talent and became inspired by Norwegian folk music.

Acclaimed as a pianist, Grieg toured Germany, The Netherlands, and Italy in 1883 and 1884. He visited England in 1888 and Paris in 1889. He declined invitations to appear in the United States because of poor health. Grieg was honored by a festival of his music at Bergen in 1898. He was buried at his home, Troldhaugen, about six miles from Bergen.

Grieg said of his music: "Artists like Bach and Beethoven erected churches and temples on ethereal heights. My aim in my music is exactly what Ibsen says about his own plays: I want to build homes for people in which they can be happy and contented." Debussy and Ravel admired his style.

JOYCE MICHELL

GRIFFIN was a strange creature of Greek mythology, with the head and wings of an eagle and body of a lion.

There was a great store of gold in a country called Scythia, far north of Greece. This place was between the land of the Hyperboreans and the one-eyed Arimaspians. The griffins guarded the gold from the Arimaspians, who were constantly trying to steal it. Apollo

went each year to the pleasant land of the Hyperboreans for a rest.

PADRAIC COLUM

GRIFFIN, WALTER BURLEY. See CANBERRA.

GRIFFITH, ARTHUR. See IRELAND (The Easter Rebellion).

GRIFFITH, DAVID WARK (1880-1948), was a pioneer American motion-picture director and producer. In 1915, he produced *The Birth of a Nation*, an epic of the Civil War and Reconstruction. It was the first full-length feature motion picture. In length and treatment of subject matter, it marked an important advance in the art of the motion picture. He is credited with starting the use of "the flash-back," "the close-up," and "the fade-out" (see MOTION PICTURE [Motion-Picture Terms]).

Griffith was born at La Grange, Ky., and attended the University of Kentucky. Before entering motion pictures, he acted in and managed road companies that presented stage plays. Among his other successful films were *Intolerance*, *Broken Blossoms*, *Way Down East*, and *Orphans of the Storm*.

BARNARD HEWITT

GRIFFON is a medium-sized hunting dog that originated in The Netherlands in the 1800's. It is commonly called the *wire-haired Pointing griffon*. The dog, a good



Evelyn M. Shafer

The Large, Wire-Haired Pointing Griffon makes an excellent hunting dog. It will go great distances to retrieve game and will also retrieve game from water.

retriever, shows where game is by pointing. It has a rough, steel-gray coat, with splashes of chestnut. The dog works slowly and deliberately, following its game by scent. Owners usually cut off about two thirds of the tails of their dogs. The griffon stands 19 to 23 inches high at the shoulder, and weighs 50 to 60 pounds.

WILLIAM F. BROWN

GRIGNARD, gree NYAHR, FRANÇOIS AUGUSTE VICTOR (1871-1935), a French organic chemist, discovered the most widely used method for making carbon compounds. He won the 1912 Nobel prize for this work. It made possible new medicines, perfumes, and detergents. In 1900, following the lead of his professor, Phillippe Barbier, Grignard found that magnesium

combines with a large number of complex compounds. When he treated these combinations with water, he obtained new substances. He spent most of his life working out the details of his method, which chemists in all parts of the world adopted. By the time he died, scientists had published about 6,000 papers on his work. Grignard was born at Cherbourg, and taught at the universities of Lyons and Nancy. **HENRY M. LEICESTER GRILLPARZER, FRANZ.** See **GERMAN LITERATURE** (Romanticism).

GRIMES, JAMES WILSON. See **IOWA** (Famous Iowans).

GRIMM is the family name of two German brothers. **Jacob Ludwig Grimm** (1785-1863) and **Wilhelm Carl Grimm** (1786-1859) collected, retold, and published the world-famous *Grimm's Fairy Tales*. This work was translated into English in 1824.

Jacob Grimm, an outstanding linguist, was one of the founders of the present-day science of language. His *German Grammar* (1819), a comparative and historical approach to grammatical problems, contains *Grimm's Law*, explaining the correspondences between certain consonants in the Germanic languages and those in early Indo-European languages. His *History of the German Language* (1848), greatly influenced linguistic science. With Wilhelm, who collected and published *Germanic Heroic Legends* (1829), Jacob started the *German Dictionary* (1854), which became a model for contemporary dictionaries.

The brothers were born in Hanau. After studying at the University of Marburg, Jacob went to Paris and became the librarian of Jerome Bonaparte, King of Westphalia and brother of Napoleon I. In 1829, Jacob became professor of Germanic languages and Wilhelm the librarian at the University of Göttingen. In 1841, both Jacob and Wilhelm became professors at the University of Berlin.

G. F. MERKEL

See also **GRIMM'S FAIRY TALES**.

Jacob and Wilhelm Grimm Collected Fairy Stories.

BROWN BROS.



GRIMM'S FAIRY TALES is a collection of German folklore. The folk and fairy tales of many countries have been collected for us mostly by a few people who were willing to hunt for them and write them down. The old German fairy tales have become known the world over because of the work of two German brothers, Jacob and Wilhelm Grimm. The Grimm brothers brought the old stories to millions to enjoy.

After these two brothers left law school, they spent weeks walking about the German countryside in search of the old stories, which until that time had been told only by word of mouth. The Grimm brothers spent most of their time in the old town of Kassel. There they sat in kitchens and gardens, and listened to grandmothers tell the stories their grandmothers had told them. They heard such stories as "Hansel and Gretel," "The Goose-girl," "Cinderella," and "Rumpelstiltskin." The two Grimm brothers wrote the stories down, and their first collection was published in 1812.

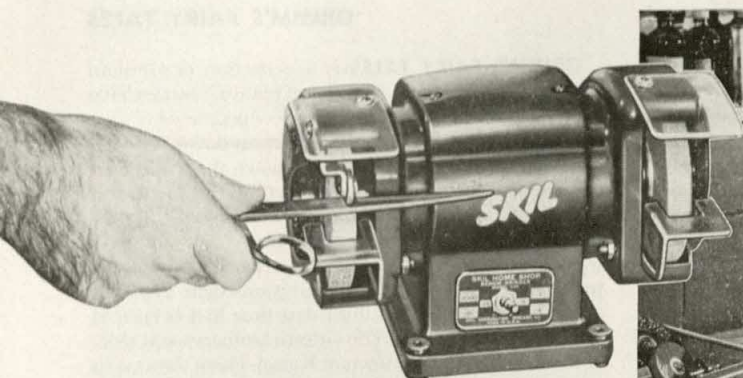
Only adults read the first book, and many found the stories dull. Later, Wilhelm took pains to use the same words the storytelling grandmothers used, and made the characters talk in a natural fashion. In this style, the stories became popular with children. The brothers published several volumes of the stories. Today the best of them are usually published in one book and called *Grimm's Fairy Tales*. Jacob Grimm was a language scholar and was interested in the histories of the tales. He saw in them the German survivals of old Greek and Teutonic myths. He showed how the Brynhild of the Teutons had become "Briar Rose" in the modern version, and how "The Poor Man and the Rich Man" was just the old Greek story of Baucis and Philemon (see **BAUCIS AND PHILEMON**).

ROLLIN S. ATWOOD

See also **FAIRY; GRIMM**.

"**Snow White and the Seven Dwarfs**," as illustrated by Wanda Gág, is one of the best loved of Grimm's fairy tales. From the 1938 edition published by Coward-McCann.





GRINDING AND POLISHING



SKIL Corp.

In the Home Workshop, craftsmen use a bench grinder and the offhand grinding method to sharpen tools, left. Jeweler's rouge is used as an abrasive for fine polishing of metalwork, right.

GRINDING AND POLISHING are two important manufacturing processes. Grinding uses abrasives to remove material, and polishing uses them to smooth surfaces. Grinding probably ranks as the earliest of all manufacturing processes. Its use goes back to prehistoric times, when ancient man shaped stone tools by rubbing them against hard, abrasive stones or other kinds of abrasive materials (see **ABRASIVE**).

Grinding

Grinding Tools. In modern manufacturing, most grinding is done by abrasive wheels that rotate at high speed, or by power-driven cloth or paper belts coated with an abrasive.

Grinding Wheels are available in many sizes and with a wide range of abrasive grains from coarse to fine. Manufacturers use *coarse* wheels for rough grinding, *medium* wheels for general sharpening and grinding, and *fine* wheels for finished grinding on products which must have an extremely smooth surface.

The most commonly used abrasives are silicon carbide, used for grinding hard brittle materials such as cast iron; and aluminum oxide, a tougher abrasive used for tool steel and wrought iron. Various cementing materials bond the abrasive grains together into a wheel. Each of these is best suited for some particular use. In most wheels, the bonding material is clay. The clay is mixed with the abrasive grains and heated so that the clay becomes a glasslike material. Water and high temperatures do not affect this material. Sometimes a silicate such as common water glass (sodium silicate) bonds wheels for grinding tools. Plastic resin bonds are also coming into use. These can be varied from hard to

soft according to use. Thin grinding wheels used for special kinds of jobs sometimes have rubber as the bonding material.

Grinding Belts use the same abrasives as grinding wheels, as well as natural abrasives such as crushed garnet and flint. Belts are used to grind metals, glass, and ceramics.

Grinding Methods. The chief grinding methods include (1) offhand grinding, (2) surface grinding, (3) cylindrical grinding, and (4) abrasive wheel cutting.

Offhand Grinding is the simplest method of grinding. The worker holds the material against the rotating wheel or belt. If the work is too large to be held conveniently, the worker may hold a small motor-driven grinder in his hand and leave the material stationary. Manufacturers use offhand grinding chiefly to sharpen hand tools such as chisels, knives, and drills, and to remove roughness and projections from various kinds of metal castings.

Surface Grinding produces a smooth and accurate flat surface on machine parts, tools, and dies. Surface grinding machines may be made with the axis of the wheel either horizontal or vertical in relation to the surface of the work.

In the *horizontal* type of surface grinder, the work is attached to a table that moves back and forth at a right angle to the axis of the wheel. The operator advances the work slightly across the wheel after each stroke until the entire surface of the work has been covered.

The *vertical* type of surface grinder uses a cup-shaped wheel. These machines often have a large, rotating table to which the work is attached. The table rotates

slowly so that the finished work may be removed and the new work attached in a single continuous operation. This saves the time necessary to remove the work, reposition it, and then fasten it down again.

Cylindrical Grinding is used to finish accurately the outer surface of shafts, pistons, and other cylindrical machine parts. This is called *external grinding*. Manufacturers also use *internal cylindrical grinding* to finish such parts as the insides of automobile cylinders and machine bearings. Cylindrical grinding can be done on a lathe or a special grinding machine.

Manufacturers use special grinding machines to grind the screw threads on hardened steel bolts, or on parts where the thread must be finely finished and accurately formed. Other special grinding machines finish the shape of gear teeth after the gears have been hardened. Grinding wheels are usually used for cylindrical grinding. But manufacturers sometimes use grinding belts on work that does not require great accuracy.

Abrasive Wheel Cutting is a variation of grinding that uses a narrow grinding wheel, usually bonded with rubber. The wheel rotates at a high speed. To keep the work and the tool cool, they are flooded with a liquid. In properly designed machines, abrasive wheels do fast, smooth work in cutting steel shafts and bars.

Polishing

Polishing is usually done with wheels made of cloth, felt, or leather coated with a fine abrasive. Abrasives used include fine grades of silicon carbide or aluminum

GRINDING AND POLISHING

oxide. For even finer polishing, *jewelers' rouge*, a fine ferric-oxide powder, or *tripoli*, a type of silica, may be used.

In some polishing work, manufacturers use abrasive belts. They may also use a special type of polishing wheel made of soft rubber with abrasive grains molded in it. The rubber wears away just fast enough to prevent the wheel from becoming clogged or glazed on the surface. Most polishing, or *buffing*, on irregularly shaped pieces is done by hand. But, for certain large-scale polishing operations, such as the finishing of stainless-steel sheets, manufacturers use large machines at high speeds.

Honing and Lapping

Honing is an operation halfway between grinding and polishing. It is done by machines that rub the surfaces to be finished with fine abrasive stones. This removes the fine scratch marks left by a previous grinding operation. It leaves the surface accurate and with a very fine finish. Manufacturers use honing on the insides of automobile cylinders, and on the bearing surfaces of crank shafts and other machine parts.

Lapping does about the same job as honing. It uses metal lapping blocks and abrasive grains. The grains are suspended in a liquid or paste binder. The abrasive is spread between the work and the moving lapping block. Manufacturers use lapping chiefly on jobs where only a small amount of metal must be removed from the finished product.

ARTHUR C. ANSLEY

See also ABRASIVE; MACHINE TOOL (Grinding); WHETSTONE.



For Polishing Work in Industry, workmen hold the tool or piece of machinery to be finished against a wheel coated with a fine abrasive.

Power-Driven Grinding Machines Used in Industry cover a large surface at one time. They are equipped with either an abrasive coated belt, below, or with rotating abrasive wheels.

Hammond Machinery Builders; Hill Acme Co.



GRINNELL COLLEGE

GRINNELL COLLEGE is a privately endowed, coeducational college in Grinnell, Iowa. Founded in 1846, it is the oldest four-year college west of the Mississippi River. The school places strong emphasis on broad liberal education, but also offers preprofessional work in medicine, law, engineering, and teaching. For enrollment, see **UNIVERSITIES AND COLLEGES** (table).

GRIPPE, *grip*. See **INFLUENZA**.

GRIS-NEZ, CAPE. See **CAPE GRIS-NEZ**.

GRISSOM, VIRGIL I. See **SPACE TRAVEL** (ASTRONAUTS and COMMANDERS).

GRISTLE, GRIEST, is another term for cartilage, the elastic material found in the skeleton of man and animals with backbones. Cartilage is a translucent, bluish-white tissue. It supports and connects other tissues of the body. It covers the ends of bones inside the joints, and makes up parts of the nose and ear. Cartilage also forms the rings of the windpipe. Most parts of the skeletons of higher animals are first formed of cartilage, which is gradually replaced by bone as the animal grows. The skeletons of sharks and related fishes are made up entirely of cartilage. See also **CARTILAGE**. MARSHALL R. CROFT

GRITS is a coarse meal made from grain, usually wheat, oats, or Indian corn. The hulled grain is ground into meal. This meal is called *grits* because it is rough like sand, rather than smooth like flour. People in the southern United States eat grits as a breakfast food and as a vegetable dish. Grits made from hulled grains of corn is called *hominy grits*. See also **HOMINY**.

GRIZZLY BEAR is a massive animal native to western North America. Large numbers of these great bears once roamed throughout the northwestern United States, but only about 500 remain. Grizzlies may grow about 9 feet long and weigh about 1,000 pounds. They eat berries, roots, small animals, and sometimes livestock. The grizzly is named for the appearance of its coat. Although its fur may be mostly brownish yellow, gray, or reddish brown, it is white at the tip. This gives it a grayish, or grizzled, look. See also **BEAR** (Kinds of Bears).

Scientific Classification. Grizzly bears belong to the bear family, *Ursidae*. They are genus *Ursus*, species *horribilis*. CHARLES P. VORHIES

GROAT was an English silver coin worth four pence. English rulers from the early 1300's to the late 1600's issued the coin. The name, since used for coins of other countries, comes from the Latin word *gravius*, meaning *thick*. English groats were thicker than previous coins. The later use of milled coins dropped English groats from circulation.

GROCERY. See **FOOD** (Marketing).

GROFÉ, groh FAY, FERDE (1892-), an American composer and arranger, became famous when he orchestrated George Gershwin's *Rhapsody in Blue* for band leader Paul Whiteman in 1924. Grofé's *Grand Canyon Suite* for orchestra (1931) is played throughout the world. He also wrote *Mississippi Suite*, *Symphony in Steel*, *Whale*, and other music describing the American scene. Grofé was born in New York City. At 14, he ran away from home. In 1919, he became Whiteman's arranger. CHARLES GORMAN

GROIN. See **ARCHITECTURE** (Architectural Terms).

GROMWELL is the name of a group of weedy plants that belong to the borage family. About 10 kinds grow in North America. The common *gromwell* grows along roadsides and in pastures in the eastern United States and Canada. It is an erect, branching plant with leaves a half inch wide. The common gromwell has greenish-yellow flowers, and bears a fruit shaped like a funnel.

Scientific Classification. The common gromwell belongs to the family *Boraginaceae*. It is genus *Lithospermum*, species *officinale*. ARTHUR CHRONQUIST

GROMYKO, groh MEE koh, ANDREI ANDREYEVICH (1909-), a Russian diplomat, became his country's foreign minister in February, 1957. He joined the Russian diplomatic service in 1939. After a year in the American affairs department of the foreign ministry in Moscow, he was sent to Washington, D.C., as counselor of the Russian embassy. In 1943, he became Russian ambassador to the United States, and served until 1946. Starting in 1946, he was chief Russian delegate at the United Nations and at many international conferences. He became known for his bitter opposition to the Western powers. From June, 1952, to May, 1953, he was Soviet ambassador to Great Britain. He served as deputy foreign minister from 1947 to 1952 and from 1953 to 1957. Gromyko, a peasant's son, was born near Minsk. ALBERT PARKS

File, Reptiles-Grazing



The Mighty Grizzly Bear can crush the skull of a bull with one stroke of its great paw. Some grizzly bears weigh up to 1,000 pounds, and are from 6 to 9 feet long.

GROOMING, PERSONAL

Well-groomed persons always look fresh and clean. They keep their hair neatly trimmed and combed, and wear clean, freshly pressed clothes. Good health makes people more attractive, so grooming also depends on eating the right foods, getting enough sleep, and exercising regularly. Grooming helps give the poise and self-confidence important to achieving popularity and success. Employers hire and promote men and women who take pride in their appearance.

Since the beginning of civilization, man has tried in various ways to improve his appearance. The early Roman women were fond of jewelry and elaborate hair styles. North American Indians often decorated their bodies with paint, and their clothing with beadwork. Some African tribesmen still tattoo designs on their bodies. People try to improve their appearance for three reasons. These are: (1) to increase their personal comfort, (2) to follow changing ideas of what is attractive or stylish, and (3) to increase their standing, or prestige, in the community.

How Health Aids Good Grooming

Good grooming depends partly on good physical and mental health. A person must feel his best to look his best. For example, a teen-ager whose diet fails to supply necessary vitamins and minerals may have blotchy skin, poor teeth, and dull, unattractive hair (see **NUTRITION** [The Basic Seven]). An improper diet can also be the cause of weight problems. If you are overweight or underweight, see your physician for a corrective diet.

Well-Groomed Young People Always Look Neat No Matter What They Are Doing.

By Associated Editors



GROOMING, PERSONAL

Sleep is nearly as important as diet for maintaining good health. Most adults try to get a minimum of eight hours of sleep each night. Since young persons use up more energy, they often require nine or 10 hours. Regular exercise also helps maintain health and a trim figure. It increases blood circulation, helps improve the posture, and promotes sound sleep.

The Importance of Cleanliness

Good grooming starts with cleanliness. It is the foundation for all other grooming procedures. No person can look his best if he is not clean.

The Daily Bath or Shower. Cleanliness begins with a daily bath or shower. This benefits the individual in several ways. It frees the skin from harmful bacteria that can cause skin diseases and unpleasant body odors. It helps the sweat and oil glands that lie beneath the skin's surface to do their work properly (see **SKIN** [The Work of the Skin]). In addition, many persons enjoy the feeling of relaxation and refreshment that a bath or shower provides.

Attention to Details. Certain areas of the body require more detailed care than others. These areas include the face, hair, teeth, hands, and feet.

The Face is the most conspicuous part of the body. It should be kept thoroughly clean, and as attractive as possible. Many grooming experts advise washing the face with mild soap and warm water at least twice a day. Rinsing with cold water can be helpful if the skin

is oily. If you have acne or unsightly blackheads, consult your doctor for the proper treatment (see **ACNE**; **BLACKHEAD**).

Many girls use cosmetics to add color to the face, or to cover small blemishes. The most widely used cosmetics include lipstick, face powder, rouge, and eye make-up. In general, the less make-up used, the more fresh and natural-looking the face will be. See **COSMETICS**.

The Hair serves as a frame for the face. It should be worn in a style that is comfortable and becoming to the individual. Many girls try to diversify their hair facial shapes, then select flattering hair styles. See the dressing of facial shapes and hair styles with this article.

A good shampoo should be used to clean and condition the hair. The nature of the scalp usually indicates how often the hair should be shampooed. An oily scalp may need to be

GROOMING, PERSONAL

washed twice a week, while a dry scalp may need shampooing only once in two weeks. After shampooing, a girl should be careful to rinse her hair thoroughly to remove all soap oils or films that might tend to dull the high lights of her hair.

Brushing and massage are important parts of hair grooming. Brushing stimulates the scalp and helps remove dirt and excess oil. The brush should have bristles stiff enough to stimulate the scalp, but not irritate it. Dandruff, which is composed of skin particles thrown off by the scalp, can sometimes be reduced by frequent brushing (see DANDRUFF).

Teeth. The plainest individual can look attractive with a winning smile that shows well-cared-for teeth. The teeth should be brushed after each meal if possible, to reduce the danger of decay and mouth odor (see TEETH [Care of the Teeth]). Unpleasant breath can be further controlled by the use of an antiseptic mouthwash, or by using mints and chewing gums prepared especially to combat bad breath.

Hands. Every good grooming routine includes a set of procedures designed to make the hands more attractive. A person should wash his hands with soap and warm water as often as necessary. He may use a small brush to loosen grime around the fingernails. Since frequent washings have a drying effect on the hands, many girls use hand lotions or creams to restore the natural skin oils.

Care of the hands should include *manicuring*, or keeping the fingernails trim and neat. The nails must be clipped and neatly filed with an emery board. The *cuticle*, or skin that surrounds the fingernail, should be trimmed frequently with small cuticle scissors. Girls often apply a protective coating of clear or colored polish to the nails.

Feet are an active part of the body, so extra care is needed to keep them attractive. The feet should be washed as often as necessary, and deodorant powders or creams applied. If your feet itch or ache, soak them in warm or hot water. A *pedicure*, which employs steps similar to those of a manicure, should be used to groom the toenails.

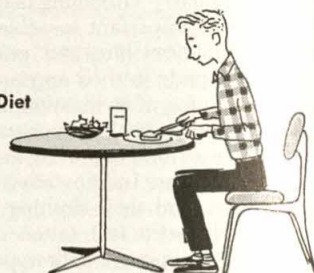
The Importance of Clothing

Nearly everyone likes to "dress up" for a special occasion. For example, a high-school girl going to a prom usually plans what she will wear long before the evening of the dance. But a well-groomed individual tries to dress as neatly every day as he does for special

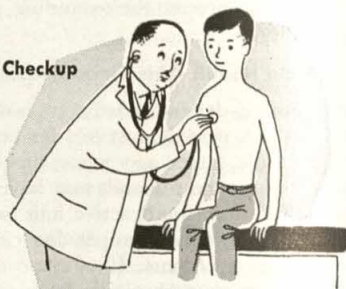
GROOMING HINTS

Good grooming helps make people popular and successful. It depends on cleanliness, neat clothes, the proper diet and exercise to maintain good health, and many other factors.

Proper Diet



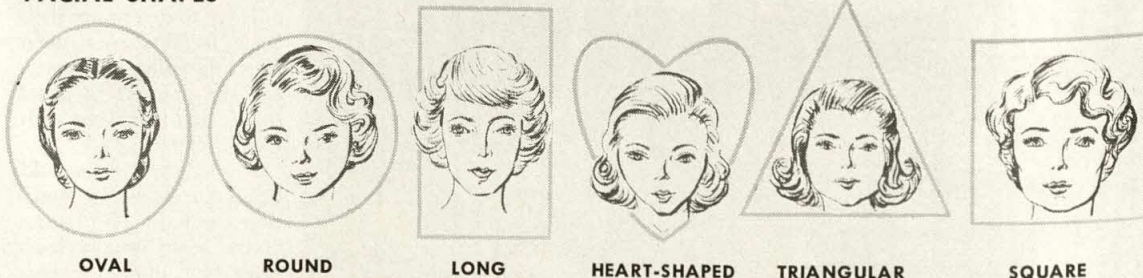
Health Checkup



occasions. The person who develops a routine to care for his wearing apparel can look attractive at school, at work, or at play.

Selecting a Wardrobe. The most important rule when shopping is to buy clothes that are complimentary. Buying a sweater because it is "stylish," or because a friend has one like it, can often be a mistake. Outfits that flatter the figure, complexion, and coloring make the best choices. A wardrobe should also suit the particular personality and age level of the individual. Try to select clothes that emphasize good features and minimize faults. For example, a girl who is tall and thin should wear wide belts, turtle-neck sweaters, and blouses with rounded or wide-spread collars. Thin persons look most attractive in warm, bright colors, plaids, and checks. A girl with a small clothes budget might stretch her dollars by buying clothes that can be worn in various combinations. A blouse that can be matched with any of several skirts in a girl's wardrobe is a much wiser

FACIAL SHAPES



OVAL

ROUND

LONG

HEART-SHAPED

TRIANGULAR

SQUARE

Becoming Hair Styles for women depend on the shapes of their faces. The drawings above show some of the basic facial

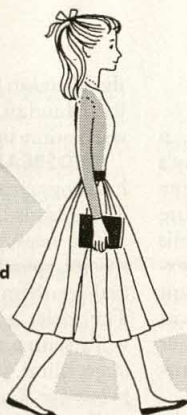
shapes and hair styles to flatter them. Women should always select the hair arrangement that most compliments their facial shape.

Adapted from *Guide to Good Grooming* by Patricia Stevens, illustrated by Gretchen Roger, © 1954 by Science Research Associates, Inc., Chicago.



Cleanliness

Good



Posture

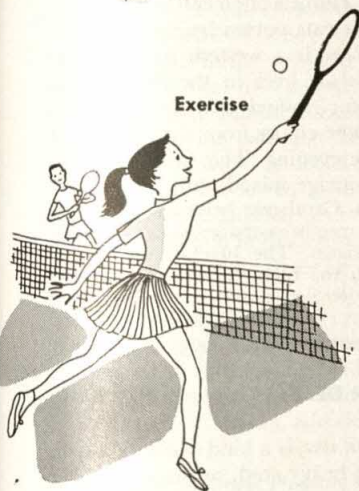
Bad



Well-Cared-For Clothes



Exercise



Neat Hair



purchase than a blouse that is becoming only when worn with a particular skirt.

Caring for the Wardrobe. A person who has a nice wardrobe must keep it in good condition in order to get the most service from it. Clothing must always be kept clean, pressed, and mended. Much clothing manufactured today can be machine-washed with a detergent or laundry soap. Even delicate fabrics can be safely laundered. Clothing that cannot be washed should be dry-cleaned whenever necessary. Frequent brushing also helps keep clothing clean by removing lint and dirt. After washing and pressing, clothes should be hung carefully in a roomy closet on sturdy hangers. If suits and dresses are hung neatly, they will keep their shape and will always be ready to wear. Garment bags protect clothing from dust and harmful insects. Shoes also need frequent attention. They should be kept well polished, and repaired as often as necessary.

Good Taste in Clothes may be summed up to mean wearing the right thing at the right time. People who dress to suit their activities will be comfortable and neat. For example, a girl wearing a velvet skirt might look well-dressed at a formal party, but not in a classroom. Both boys and girls find that informal attire, such as blue jeans and loafers, look trim and attractive on hikes or picnics. If you are in doubt about what to wear for a specific event, it may help to check on what other members of the group will be wearing.

Daily Grooming Check List

To check on your grooming, ask yourself these questions before leaving home each day:

1. Did I take a bath or shower?

2. Have I brushed my teeth?
3. Is my hair trimmed, neatly combed, and clean and shining?
4. Are my hands and fingernails clean, smooth, and attractive?
5. Are my shoes polished and in good repair?
6. Is every article of my clothing clean, pressed, and mended?
7. Is my outfit attractive and suitable for what I am going to do today?

Related Articles in WORLD BOOK include:

Clothing
Cosmetics
Exercise
Hair and Hairdressing

Nutrition
Posture
Teeth

Success on the Job depends in part on grooming. Employers hire and promote persons who take pride in their appearance.

Harold M. Lambert



GROPIUS, WALTER

GROPIUS, GROW *poh w*, **WALTER** (1893-), a German architect, founded and directed Germany's famed Bauhaus school. He later became chairman of the department of architecture at Harvard University. His students pioneered in expressing beauty through industrial buildings and designs that showed, rather than concealed, their purpose.



Charles Fortberg

Walter Gropius

Gropius was born in Berlin. He studied at the University of Berlin and the University of Munich. His first major buildings, the Fagus factory buildings at Alfeld (1919), had steel frames and glass walls.

They were among the most advanced examples of the architecture of their time.

In 1919, at Weimar, Gropius established the Bauhaus in order to integrate and coordinate the building arts. He brought leading architects, craftsmen, and artists to teach design and to create industrial products and buildings. When the school moved to Dessau in 1925, students and teachers under his leadership worked together to produce the new Bauhaus buildings. Among the leaders in the school were Johannes Itten, Paul Klee, László Moholy-Nagy, Josef Albers, and Marcel Breuer. Gropius resigned in 1928, and in 1934 went to London. See BAUHAUS.

In 1937, Gropius went to the United States, where he served as chairman of the department of architecture at Harvard until 1952. With Marcel Breuer, he designed houses in Massachusetts and a defense-housing group in New Kensington, Pa. His major work at Harvard is the graduate center, seven dormitories and a common building done in collaboration with a group of young associates. His books include *Rebuilding Our Communities* (1945) and *Scope of Total Architecture* (1953). WILLIAM T. ARNETT

GROS POINT. See NEEDLE POINY.

GROS VENTRE, GROS VAIN *u'*, **INDIANS** received this name (which means *big belly* in French) because the white men did not understand the sign-language gesture for these people. Other Indians, in referring to them, made a movement of both hands in front of the stomach, which meant *always hungry or boggan*.

The name *Gros Ventre* has been used for two tribes of Plains Indians: the *Arikara*, or *Gros Ventre of the Prairie*, and the *Hidatsa* (also called *Minutari*), or *Gros Ventre of the Missouri*.

The *Arikara* Indians were closely related to the *Arapaho* in language and customs. They were a warlike tribe that lived in tepees and hunted buffalo on the northern Great Plains. They were allies of the Blackfoot in driving American beaver trappers from the upper Missouri Valley. But the *Arikara* and Blackfoot later became bitter enemies. The *Arikara* now live with the *Absaroka* on Fort Belknap reservation in Montana.

The *Hidatsa* Indians, who were related to the *Crow*, lived near the Mandan on the Missouri River in present-day North Dakota. Their customs were like those of

the Mandan (see **MANDAN INDIANS**). The *Hidatsa*, with the Mandan and *Arikara*, now live on Fort Berthold reservation in North Dakota. JOHN C. KENNEDY

GROSBEAK, GROHS *REEK*, is any one of several handsome perching birds that belong to the finch family. These birds have short, thick beaks for cracking seeds.

The *rose-breasted grosbeak*, one of the most handsome species, spends its summers in the eastern United States and southern Canada. It winters in South America. The male, a little smaller than a robin, is black and white with a rose-red blotch on the breast. It has a very large, blunt, yellow bill. Farmers often call this bird the *potato-bug bird* because it eats potato beetles.

The *black-headed grosbeak* is a western species. The shy, handsome *blue grosbeak* lives in the South. The brown and yellow *evening grosbeak* is a bird of northwestern America. Its name comes from the false belief that it sings only in the evening. The *pine grosbeak* of Canada has rose-red plumage mixed with gray.

Scientific Classification. Grosbeaks belong to the finch family, *Fringillidae*. The rose-breasted grosbeak is genus *Phœniceus*, species *lutescens*. The black-headed grosbeak is *P. melanophthalmus*; the blue, *Guiraca caerulea*; the evening, *Heperiphona cerulea*; and the pine, *Pinicola enucleator*. HERBERT FRIEDMAN

See also BIRD (color pictures, Birds' Eggs; Birds That Help Us); FINCH.

GROSEILLIERS, SIEUR DE. See HUDSON'S BAY COMPANY.

GROSGRAIN, GRO GRAYN, is a kind of silk or rayon cloth. It is made with a heavy cord, or grain, running crosswise in a plain, tightly woven background. Manufacturers use grosgrain mostly in making rayon ribbon.

GROSS is the entire or total amount, sum, or weight, without any deduction for expense or waste. It is also a unit of measurement (see WEIGHTS AND MEASURES [Counting Measure]).

GROSS NATIONAL PRODUCT. See INCOME; NATIONAL INCOME.

GROSSETESTE, GROSS *test*, **ROBERT** (1175?-1253), was an English scholar, teacher, and bishop. He wrote many works on theology, optics, mathematics, and astronomy. His most famous pupil was Roger Bacon. As Bishop of Lincoln, Grosseteste was a zealous reformer and an able administrator. He defended the freedom of the Roman Catholic Church against royal interference. He was born in the county of Suffolk, and studied at Oxford. JAMES A. COBBETT and FULTON J. BROWN

GROSVENOR, GROVE *nor*, **GILBERT HOVEY** (1875-), edited the *National Geographic Magazine* for more than 50 years. During this time, he did much to create popular interest in geography and exploration.

The inventor Alexander Graham Bell, president of the National Geographic Society from 1896 to 1904, appointed Grosvenor to take charge of the magazine and make it popular. Grosvenor, then a young schoolteacher, was courting Bell's daughter. He became managing editor in 1896, and married Elsie May Bell

Gilbert H. Grosvenor

CLINTON PHOT. CO.



in 1900. He became editor in chief in 1903. From 1920 to 1954, he served as president of the society, and then became chairman of its board of directors. During the time Grosvener worked with the society, membership increased from less than 1,000 to more than 2,000,000.

Grosvener was born in Istanbul, Turkey, the son of an American professor. He attended Amherst College and Georgetown University. Three geographic areas are named for him: Grosvener Lake, Alaska; Gilbert Grosvener Range in Antarctica; and Grosvener-filiet, a mountain in Svalbard.

JOHN E. DAWSON

See also NATIONAL GEOGRAPHIC SOCIETY.

GROSS, GEORGE (1893-1959), a German painter, became famous in the 1920's for his biting satires of the military and wealthy classes, and for drawings criticizing the moral collapse of postwar society. For a time in the 1930's, his paintings became happier, but he usually painted works on social evil and war. Gross was born in Berlin. He served in the German army during World War I. Disturbed about the trend toward fascism, Gross moved from Germany to New York City in 1933. He became a citizen of the United States five years later.

GEORGE D. COLLIER

GROTE, groht, GEORGE (1794-1871), published his famous 12-volume *History of Greece* (1846-1856) after he had retired as a London bank manager. The work quickly became a classic, though later research has shown inaccuracies. In addition to his historical in-

Painter George Gross produced satires of German life in the 1920's and 1930's. *The Engineer Heartfield*, below, satirizes the inhuman, machine-like attitude of Germans at that time.

Collection: Museum of Modern Art, Gift of R. Gropius and Gropius



GROUND-HOG DAY

terests, Grote worked actively for political and social reforms. He was a member of parliament from 1832 to 1841, and helped found the University of London. He was born in Kent.

GEORGE F. HILLERY

GROTEFEND, GEORG. See CUNEIFORM.

GROTIUS, GRO shi us, HUGO (1583-1645), a Dutch lawyer, theologian, statesman, and poet, is considered the founder of international law. He wrote *On the Law of War and Peace*. Grotius was born HUGO DE GROOT in Delft and at 15 was graduated from the University of Leiden. He became chief magistrate of Rotterdam in 1613. He was condemned to life imprisonment in 1619 because he opposed strict Calvinism. His wife helped him escape. From 1635 to 1645, Grotius served as the Swedish ambassador to France. See also INTERNATIONAL LAW.

DIANE J. DIERCKA

GROTON, GRAHT'n, Conn. (pop. 16,111; alt. 42 ft.), is the birthplace of the atomic submarine. The *Nautilus* was launched there in 1954. The city lies across the Thames River from New London. For location, see CONNECTICUT (color map). Other manufacturing industries in Groton produce castings, engines, pharmaceuticals, and thread. It is the home of a Coast Guard training station and a large submarine base. New Londoners settled Groton in 1649. The community was incorporated as a town in 1705. Groton has specialized in shipbuilding since colonial days. The U.S. Navy established the submarine base in 1915. Groton has a representative town meeting form of government.

ALBERT E. VAN DUSEN

GROTON COAST GUARD TRAINING STATION, Conn., provides advanced and technical training for the U.S. Coast Guard. It covers 75 acres on the water front at Avery Point in Groton. The station includes the Coast Guard Institute and 22 other schools. The institute operates as a correspondence school. The station was established in 1942.

GROULX, ABÉ LIONEL. See CANADIAN LITERATURE (Since 1900).

GROUND, in electricity, is an electrical conductor that is connected to the earth to complete a circuit. In electrical telegraph transmission, the earth is used as a return conductor for telegraph currents. In electrical equipment, such as household appliances, the ground conducts electricity that may build up in the appliance because of a "leak" or a short circuit. If the appliance were not grounded, the high voltage it acquires might kill someone. In some electrical equipment, the metal frame serves as a ground.

RENEE BOLT

GROUND CONTROLLED APPROACH. See AIRPLANE (Landing the Plane); AVIATION (color diagram, Ground Controlled Approach); RADAR (Aviation).

GROUND CUCKOO. See ROAN RENNER.

GROUND HEMLOCK. See YEW.

GROUND-HOG DAY is based on a custom that people from Germany and Great Britain brought to America. They believed that it was a time for forecasting the weather for the next six weeks. According to legend, the ground hog, or woodchuck, awakens from his long winter sleep on February 2. He sticks his head out of his home in the ground and looks around. If the sun is shining and the ground hog can see his shadow, he is frightened and runs back into his hole. This is supposed to mean that there will be six more weeks

GROUND OBSERVER CORPS

of winter weather. But if the day is cloudy and the ground hog cannot see his shadow, he stays out of his hole, indicating that spring weather will soon come. Science has not confirmed this. ELIZABETH HOUGH SECHRIST

See also CANDLEMAS DAY; WOODCHUCK.

GROUND OBSERVER CORPS (GOC) operated aircraft warning stations for the United States Air Force from 1949 to 1959. The GOC reached its peak strength in 1955, when more than 400,000 unpaid civilian volunteers manned over 18,500 individual observation posts and 72 air-defense filter centers. It was placed on a part-time reserve status in 1958.

GROUND PINE. See CLUB MOSS.

GROUND SLOTH is a huge, extinct animal of the sloth family. It was given this name because, unlike present-day sloths, it did not climb trees. The largest ground sloth was nearly the size of an elephant, and about 20 feet long. Its bones were heavy and massive.

The feet of the ground sloth were unusual. They had long claws placed in such a position that the animal must have walked on its knuckles, with only the outside edge of the foot resting on the ground. The heavy strong structure of the hind legs and tail suggests that the ground sloth must have been able to rise on its hind legs to reach high branches and leaves. It fed only on plant, or vegetable, matter. The ground sloth originated in South America, but during the Ice Age these animals lived in the United States.

Scientific Classification. The giant ground sloth belonged to the family *Megatheriidae*. It made up the genus *Megatherium*.

SAMUEL PAUL WELLES

See also SLOTH.

GROUND SQUIRREL is a popular name for any burrowing member of the squirrel family. See CHIPMUNK; MARMOT; PRAIRIE DOG; SQUIRREL; WOODCHUCK.

GROUND WATER is water that has sunk into the ground and is held beneath the surface. Rain water sinks through the top layers easily. The earth near the surface is full of tiny spaces. Even the rocks there have cracks and pores through which water can find its way. But when water gets far enough down, it reaches clay, shale, or impervious rock, and cannot sink farther.

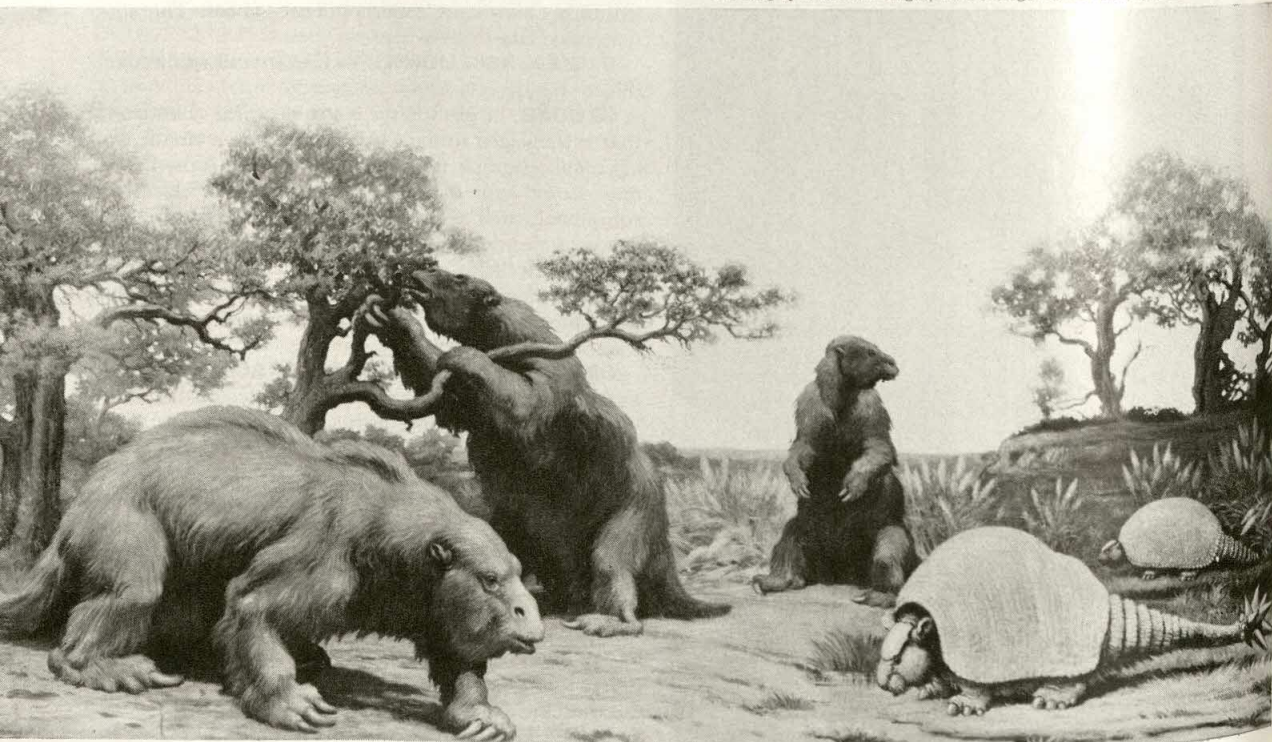
In other places, the earth becomes packed so tightly by the immense weight of the ground above that the pores and openings are squeezed shut. Here, too, the water can sink no farther, and there does not seem to be much ground water below 2,000 or 3,000 feet. It has been found more than 6,000 feet deep, but is believed to be rare at 10,000 feet and absent at 20,000 feet.

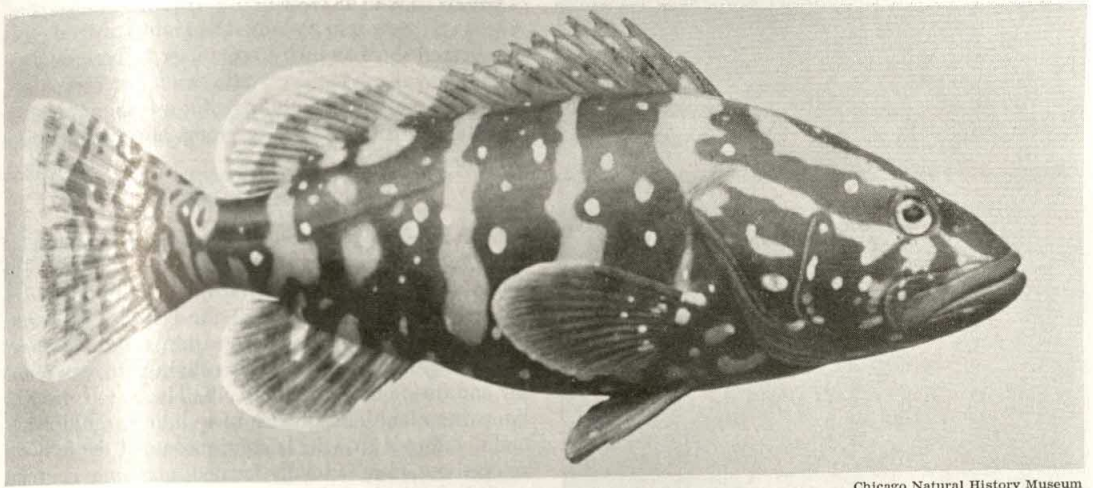
As more and more water sinks into the ground, it begins to collect above the bedrock or the dense soil. When the ground has as much water as it can hold, it is said to be *saturated*. The ground becomes saturated from impervious bedrock or dense soil up, and the top level of the *saturated zone* rises toward the surface. This top level is called the *water table*. The dry ground above the water table is called the zone of *aeration*, or the *vadose zone*. After heavy rains, the water table is nearer the surface. In dry weather it drops again, as the ground water is used up.

Sometimes a valley, or perhaps the side of a cliff, reaches down to the saturated zone, and the water flows out of the ground from permeable rocks, joints, or open structures. If the opening is small, there is a spring, which may form a brook. If a valley sinks deep into the saturated zone, the water may flow out to form a lake.

Hairy Ground Sloths, left, and Armored Glyptodonts, right, Roamed over America About 1,000,000 Years ago.

Painting by Charles R. Knight, from Chicago Natural History Museum





Chicago Natural History Museum

The Many-Colored Nassau Grouper Lives in Tropical Ocean Waters from Key West, Fla., to Brazil.

Sometimes an area dips only a little below the water table. The water oozes up and forms a swamp.

A well is merely a hole dug down into the saturated zone. In an *artesian well*, the water spouts out under pressure.

ELDRED D. WILSON

See also **ARTESIAN WELL**; **GEOLOGY** (Water in the Ground).

GROUNDNUT. See **PEANUT**.

GROUP BANKING. See **BANKS AND BANKING** (Banking Systems).

GROUP DYNAMICS includes the forces that work on any group of persons and determine what it does. The group may be a club, a business organization, an army, or even an entire nation.

Before 1900, scientists knew little about the forces at work in groups. Then sociologists, and later psychologists, anthropologists, political scientists, and educators began using the tools of science to probe the mysteries of group life. Beginning in the 1930's, group dynamics became a recognized field of study for scholars in the social sciences. Several universities have established special research groups to study group dynamics.

A large body of knowledge has been built up about group dynamics. This knowledge has shed light on such aspects of group life as the nature and requirements of leadership, the different roles of members of a group, the factors that affect organization and operation, and the process of making decisions in a group. The research also has provided information on communications and relationships among members in a group, and the hidden forces that influence what people do in groups. This basic research has led to new ideas about what makes a good group and a good group leader.

Attempts have been made to translate the findings of basic research in group dynamics into practical principles and techniques. This *applied* group dynamics has produced new training programs for group members and leaders. For example, one such program involves people living together for a few days to several weeks. The people observe their own behavior and gain new insights about how their actions affect others.

Much of the money used to finance research in group dynamics comes from industry, government, and na-

tional voluntary organizations. These organizations are using applied group dynamics in improving leadership and group operation.

MALCOLM S. KNOWLES

See also **SOCIAL PSYCHOLOGY**.

GROUP HOSPITAL AND MEDICAL PLANS. See **INSURANCE** (Accident and Health).

GROUP INSURANCE. See **INSURANCE** (How Life Insurance Is Sold).

GROUP OF SEVEN. See **CANADA** (The Arts).

GROUP THERAPY. See **PSYCHOTHERAPY**.

GROUPE is an ocean fish that lives in warm and temperate seas, mostly around rocky shores and coral reefs. All the many kinds of groupers have large mouths. They feed on fish and marine animals, and swallow them whole. Fishermen catch this popular fish on a hook baited with fish or shrimp. In color, they resemble the corals and algae among which they live. They can change their colors quickly. The *red grouper* lives along the southern Atlantic Coast to Brazil. Other groupers of the southern United States coastal waters are the *Nassau grouper* and *black grouper*.

Scientific Classification. Groupers belong to the family *Serranidae*. The red grouper is genus *Epinephelus*, species *morio*; the Nassau grouper, *E. striatus*; and the black grouper, *Mycteroperca bonaci*.

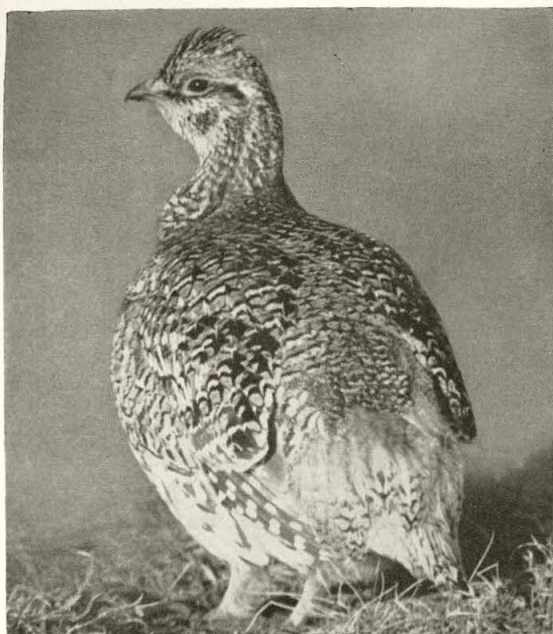
LEONARD P. SCHULTZ

See also **FISH** (color picture, Tropical Salt-Water Fishes); **JEWFISH**.

GROUSE is a bird that lives in the Northern Hemisphere. It is somewhat like domestic fowl. People often use the names *grouse*, *quail*, and *partridge* incorrectly. In the South, the ruffed grouse is often called a pheasant. New Englanders call it a partridge. The *Canada spruce grouse* is called the swamp or spruce partridge. In other places, partridges and pheasants are often called grouse. Several grouse are called quail.

General Appearance. A grouse has dull feathers, and grows about the size of a large chicken. Like a fowl, it has four toes, with the hind one raised above the ground. Feathers hide its nostrils. These birds usually live in high or northern places. Feathers cover the legs of most species to keep them from freezing.

Habits. During the mating season, the males court the hens with a kind of dance, and fight each other fiercely. Grouse build their nests on the ground in well



Alfred M. Bailey and R. J. Niedrach

The Sharp-Tailed Grouse has drab-colored feathers and is about the same size as a barnyard fowl. It is a favorite with hunters of game birds, because its meat makes good eating.

hidden places. The hens usually lay 10 to 15 eggs of buff color with brown dots. The chicks leave the nest almost as soon as they hatch. When danger threatens, the mother gives a sharp call that warns the chicks. A flock of grouse is called a *covey*.

Grouse eat insects and berries in summer. In autumn, they may visit grain fields for the seeds, and in winter they live on catkins, leaves, and buds. Their food habits usually do not harm growing things. In Europe and North America, grouse gradually increase and then grow scarce over 9- to 11-year periods. They are good game birds, because they show intelligence in escaping from hunters.

Many species of grouse live in North America. The *ruffed grouse* lives from Alaska to Georgia, and the *Canada spruce grouse* lives from New England to Alaska. Some grouse, including the Canada spruce grouse, are called *fool hen*, because they are curious and often stand watching a hunter and so are easily shot.

Scientific Classification. Grouse belong to the family *Tetraonidae*. The ruffed grouse is genus *Bonasa*, species *umbellus*.

JOSEPH J. HICKEY

Related Articles in **WORLD BOOK** include:

Bird (How Birds	Partridge	Quail
Protect Themselves)	Poultry	Ruffed Grouse
Heath Hen	Prairie Chicken	

GROVE CITY COLLEGE is a coeducational liberal arts school at Grove City, Pa. Founded in 1876, it is affiliated with the Presbyterian church. The college offers courses in liberal arts, science, applied science, commerce, and music. It grants the A.B., B.S., B.S. in Commerce, and B.M. degrees. The college also has two-year courses in secretarial studies, prenursing, and premedicine, and provides Air Force ROTC training. For enrollment, see **UNIVERSITIES** (table).

GROVES, LESLIE R. See **MANHATTAN PROJECT**.

GROWTH is an increase in size. All living things grow. A seed can grow into a plant. The giant redwood grows from a seed $\frac{1}{16}$ of an inch in diameter to become a tree often more than 300 feet tall. Scientists must use a microscope to see a whale egg, but a full-grown whale may be more than 100 feet long and weigh about 160,000 pounds.

How Growth Takes Place

In Living Things. Every living organism consists of cells. Each individual begins life as a single cell. The cell takes in materials and builds them into *protoplasm*, the living substance of which the cell itself is made. Thus, the single cell grows from within, a process known as *growth by intussusception*. This cell, in turn, can multiply and divide to form other cells. These, too, grow by intussusception. The process of building, multiplying, and dividing is growth. It continues until the fully developed organism is finally formed, and may continue until the individual dies.

As the cells grow, they also change in character. Some grow into the tissues that form skin. Others grow into muscle tissues. Still others form body organs such as the heart, lungs, and liver. This growth and organization of the cells into specific structures is called *differentiation*. The process of differentiation follows definite rules. The seed of a redwood always grows into a redwood tree, not into a pansy or an oak tree. A dog's tail always grows at the base of his spine, not between his ears. The rules of differentiation are called *heredity*. The new cell from which an individual grows contains the hereditary traits that influence certain chemical and physical processes in the cell to make it grow into the correct individual. See **HEREDITY**.

Other kinds of regulators are also produced by the cells. As growth proceeds, certain cells develop that produce specific substances that influence and regulate the further development of the organism. These substances are called *hormones*, and are found both in plants and in animals. See **HORMONE**.

In Nonliving Things. Some substances that are not alive also exhibit a kind of growth. Objects like rocks can increase in size if they are in a proper environment. Some scientists consider this a form of growth even though the cells within the object do not themselves multiply and divide. The growth of a rock or mineral is called *growth by accretion*. For example, water dripping from the ceiling of a cave leaves behind exceedingly tiny mineral particles. These particles cling together until, after hundreds of years, they form great "icicles" of stone, called *stalagmites* and *stalactites*. Should one of these icicles be broken, and the water continued to drip, the stone icicle would grow again.

Plant Growth

Scientists divide all plant life into two major groups. One group, called *thallophytes*, includes plants that use simple substances such as carbon dioxide, sunlight, and water to make the complex organic compounds needed for their growth. All green plants belong to this group. The other group, called *embryophytes*, includes plants that cannot use simple substances for growth, but must obtain ready-made complex compounds for food. Among these plants are the fungi. See **EMBRYOPHYTE**; **THALLOPHYTE**.

Growth Influences. The growth of plants differs from that of animals in several ways. In most plants, the form they must take is not as fixed as it is in most animals, their growth is influenced by hormones produced within themselves. But, unlike most animals, plants show certain growth responses to changes in their environments.

External Influences. Such external factors as heat, light, humidity, soil composition, and even gravity, exert great effects on plant growth. For example, roots of plants grow downward and the plant itself upward. If a house plant in a pot is turned upside down and allowed to grow for some time, the plant will turn to grow upward. If the roots are examined, they will be found to be growing downward. Another example is the response of plants to sunlight. If potted plants are placed near a window so that light comes from the side and not from above them, their leaves turn toward the light, and often the tip of the plant also bends in that direction.

Internal Influences. Scientists have studied the influences of *auxins*, or plant hormones; animal hormones; and vitamins on plant growth. They found that giant flowers and fruits can be produced by providing plants with vitamins and hormones that are also important to animal growth. Therefore, scientists believe that certain chemical processes carried on within cells are common to plants and animals.

How Plants Grow. Most plants grow in height only at their tips. At each tip of a branch or stalk, and also at root tips, there is a center at which cell division occurs rapidly.

The trunk and limbs of a tree grow in size when new cells form a layer, called the *cambium*, just under the bark. During each growing season, a new cambium

layer forms. Because the cells that grow in the spring are larger than those that grow in autumn, each cambium layer forms a distinct ring. Therefore, when lumbermen cut a tree, they can tell its age by counting the number of rings. If they look carefully, they can also tell something about the kind of growing conditions that existed each year. If the rings are wide, the growing season was good. But if the rings are small, the growing season was poor. See TREE (The Wood).

Regrowth of Parts. Plants have great powers of *regeneration*, or the ability to grow new parts. If their leaves or branches are removed, new ones grow. In some kinds of plants, new plants will grow when a single leaf is planted. In others, such as roses and geraniums, new plants can be developed by cutting a portion of the stem and planting it. Plants that grow from these cuttings are exactly like the parent plants if they remain in the same environment. Commercial plant growers find this plant habit quite useful. For example, they grow seedless oranges from cuttings.

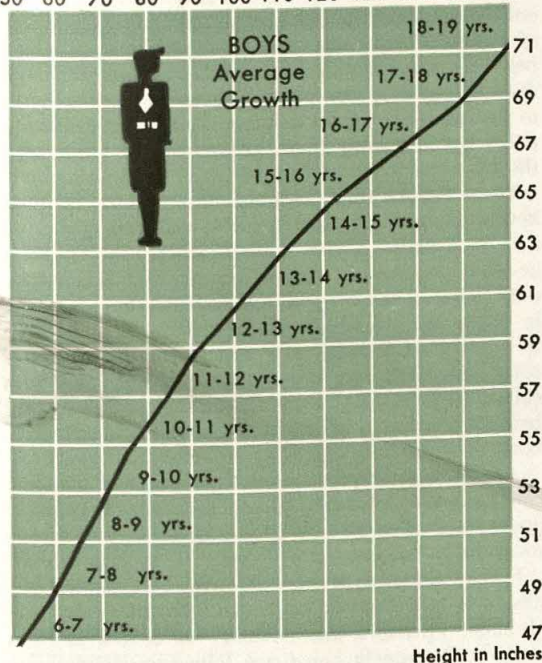
Growth of Animals

In some animals, particularly the lower forms, striking changes take place between the time the single cell starts to grow and the time an adult individual emerges. For example, the single cell of some insects grows first into a wormlike *larva*. The larva, in turn, enters a *pupal*, or quiet, stage before the adult insect finally develops. Even among the higher animals, striking transformations occur as the animal develops. For example, the single cell of a frog develops into an egg. The egg hatches into a water-dwelling tadpole. Finally, the tadpole grows legs and lungs as it transforms into an adult

AVERAGE NORMAL GROWTH FOR BOYS AND GIRLS

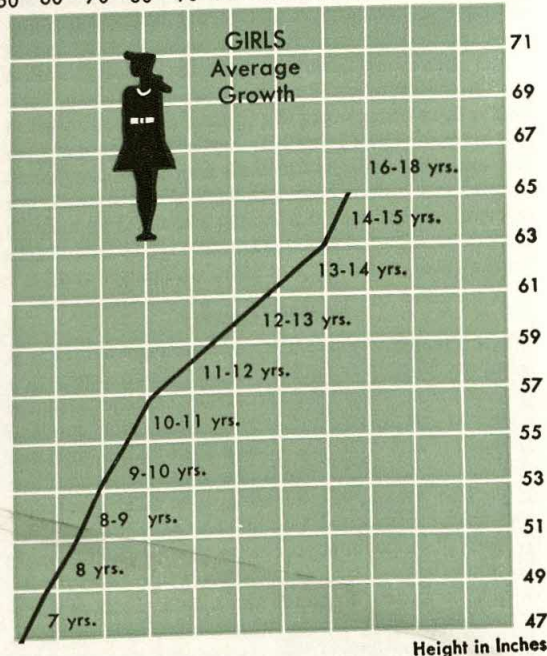
Weight in Pounds

50 60 70 80 90 100 110 120 130 140 150 160



Weight in Pounds

50 60 70 80 90 100 110 120 130 140 150 160



GROWTH

frog able to leave the water for prolonged periods. See METAMORPHOSIS.

Among the higher *vertebrates*, or animals with backbones, the tiny cell develops steadily into a form that resembles the adult at birth. Although there are great differences in proportion of various parts of the body, the newborn animal looks like the adult.

When animals are provided with the proper food, their growth depends on heredity and on hormones produced by certain endocrine glands. Among these glands are the pituitary, the thyroid, and the sex glands. Removal or damage of any of these glands results in characteristic deficiencies in growth. For example, scientists found that if they removed the thyroid glands of tadpoles, the tadpoles would not grow into frogs. They also found that if they removed the pituitary gland from a young rat, the animal remained small or dwarfed. But if the scientist injected pituitary extracts into immature rats, they would grow much larger than other rats born at the same time.

Comparative Growth. All parts of animals grow. Sometimes one part grows faster than the others. For example, the head and brain grows fast early in the lives of all animals with backbones. Their legs sometimes increase faster than the rest of their bodies. For example, *foals*, or young horses, have quite long legs compared with the rest of their bodies. Some parts of an animal's body continue growing after others have stopped. The incisor teeth of rats continue to grow throughout their life.

Various animals have shells that keep them from growing beyond a certain size. Some, like the chambered nautilus, build additions to their shells from time to time. Others, like the crabs, shed their shells and construct larger ones.

Regeneration is a special power of growth. When a part of an animal is injured, sometimes the lost tissue can be replaced by the same kind of tissue. But sometimes the wound must be filled with another kind of tissue, called *scar tissue*. Sponges carry on regeneration almost indefinitely. Starfishes can grow whole new bodies from a single ray if a little of the center portion is left. Worms can grow new heads. Lizards can grow new tails. But in higher animals the power of regeneration is not so great. For example, if a bear's paw is cut off in a trap, a new one cannot grow. When a dog's tail is cut off, a new one does not replace it. A horse cannot grow a new leg to replace a damaged one.

Human Growth

Early Development. During its first stages of development, the human organism is known as an *embryo* (see EMBRYO). The embryo develops slowly. When it is about 2 months old, it is only about $1\frac{1}{2}$ inches long, but has the form of a human being. Although all the parts are well formed, the head is quite large compared with the trunk and limbs. At this time, the fully developed embryo becomes known as a *fetus*. At 7 months, the fetus weighs about 2 pounds and is about 15 inches long. Two months later, or just before birth, the fetus usually weighs about 6 to 8 pounds and may be from 19 to 21 inches long. Thus, by the time a baby is born, he is growing very rapidly.

Growth Rate. The rapid rate of growth continues for the first part of the baby's life. Scientists measured the height of some persons every six months from the time they were born until they were 18 years old. The investigators found that boys and girls grow most rapidly during the first two years of their lives. Then, their growth rate became gradually slower until they reached adolescence. But for about two years during their adolescent period, the boys and girls suddenly grew rapidly. This is what some people call the "adolescent spurt" in height growth. Although all adolescents develop this spurt in height, it varies with the individual. In some individuals, it begins earlier than in others. In some, it continues over a longer period. In some, the rate of growth is intense. This means that these individuals grow taller faster.

Adolescent boys usually exhibit this spurt of growth between the ages of 13 and $15\frac{1}{2}$ years. Their gain in height often ranges from 4 inches to 12 inches. But the fastest rate of growth in boys may take place any time between the ages of 12 and 17.

The adolescent growth spurt in girls usually begins about 2 years earlier than in boys, and their maximum growth rate is somewhat less than that of boys. Men are larger than women, chiefly because of this difference in the adolescent growth spurt. Until that period is reached, the average heights of boys and girls are almost the same.

Skeletal Age. Because children grow and develop at different rates, scientists have found it useful to devise methods for assigning developmental ages rather than *chronological*, or calendar, ages to growing children. As a result of much research, scientists developed an atlas of standards based on the growth of the bones of the skeleton. Doctors often use this atlas to evaluate growth. To do this, the doctor takes an X-ray picture of the bones of the person's hand and wrist to compare with the atlas. If a child is developing slowly, he could actually be 6 years old, but his bone structure might only have reached that of a 5-year-old. The skeletal age of a person who matures late could run consistently below his actual age until he becomes an adult. Certain diseases may slow down bone growth. Doctors are able to determine the extent of such *retardation*, or slowing down, by comparing X-ray pictures of the hand with the atlas.

When People Stop Growing. Most healthy human beings stop growing some time between the ages of 18 and 30. Usually, a person is tallest when he is about 20 years old. But his weight may continue to increase until he is well into his 40's. After a person stops growing in height, he actually begins to shrink. This decrease in height is exceedingly slow and usually does not become noticeable until the person reaches old age. It is caused by a thinning of the pads of cartilage that grow between the bones of the vertebral column, or backbone.

Also, in elderly persons the curves in the vertebral column tend to become greater. This results in the bent appearance of many old people, as well as a further reduction in height.

Factors Affecting Human Growth. Tall parents usually have tall children, and short parents have short children. Therefore, the tendency to be tall or short seems to be largely hereditary. However, tallness ap-

pears to be *recessive*. This means that short parents may have tall children. When one parent is tall and the other short, the children may be tall or short or even midway between. This occurs because the hereditary pattern is somewhat complex, and factors other than hereditary are often involved.

We are apt to think of some races and nationalities as tall or short. Japanese, Chinese, and Italians are generally considered shorter than people of other countries. Yet investigators have found that persons born and reared in the United States, even though their parents are Italian, grow as tall and as heavy as other Americans. Children of Japanese parents born in California tend to be taller than their parents.

Foods are a factor in growth. But not all foods have the same effect. Certain materials essential for growth can be obtained from some foods but not others. To promote proper growth, a person should eat a balanced diet that contains proteins, minerals, and vitamins, as well as sugars, fats, and starches. See **NUTRITION**.

Besides food, other factors affect growth. Communicable diseases interrupt growth. Strain and emotional disturbances can also interfere with growth. Hormones produced by glands in the body modify growth in various ways. Secretions from the pituitary and thyroid glands particularly affect growth (see **GLAND**).

Comparative Rates of Growth. Some children are fast growers, others are slow growers. Some individuals have heavy bones and weigh more than individuals with light bones. Thus it is impossible to use height-weight-ages to tell what a child should weigh.

Studies seem to indicate that for several generations people have been increasing in size. Suits of armor worn by knights of the Middle Ages are too small for the average man of today. Measurements show that Harvard University students are $1\frac{1}{2}$ inches taller and 10 pounds heavier than their fathers were when they were in college. Studies done on girls show similar increases in height and weight.

Influence of Growth. During spurts of growth, children use energy in the process of growth itself. They need additional food and rest. Investigations indicate that it is more difficult to study, to pay attention, and to withstand strain during this time.

Sometimes a boy grows so much more slowly than his friends that he worries. But his growth spurt will probably come during a later period. Rapidly growing girls need to realize that other girls may soon catch up with them.

W. B. YOUMANS

Related Articles in WORLD BOOK include:

Arithmetic	Forest and Forest	Gibberellic
(picture)	Products (picture, Nine Years	Acid
Child (Growth and Behavior; Change and Growth)	in the Life of a Tree and a Boy)	Maturation
		Teen Age (Physical Growth)

GRUB is the name given to the larva of many beetles, some true flies, wasps, bees, and certain moths. Generally a grub is short, stout, and moves slowly, if at all. White grubs that live in the soil are the young of June beetles. Bot flies, during their grub stage, feed under the skins of animals. Grubs of long-horned beetles make their homes in wood. Some are said to have lived in wooden furniture for 45 years.

LEWIS J. STANNARD, JR.

GRUBER, EBERHARD. See **AMANTITES**.

GRUENING, ERNEST. See **ALASKA** (Famous Alaskans).

GRUENTHER, GROOM *thur*, **ALFRED MAXIMILIAN** (1899-), commanded the military forces of the North Atlantic Treaty Organization (NATO) from 1953 to 1956. A gifted staff officer and administrator, he contributed to the unity and morale of the NATO alliance.

Gruenther was born at Platte Center, Neb. He was graduated fourth highest in the United States Military Academy class of 1919. When General Dwight D. Eisenhower took command of Allied forces in World War II for the North African invasion of 1942, he brought Gruenther to London to help plan the campaign. For the rest of the war, Gruenther worked continuously in Allied and American staff operations in the European war theater.

He was the first deputy commander of the National War College, and served as director of the joint staff of the Joint Chiefs of Staff from 1947 to 1949. He was promoted to general in 1949. Eisenhower took him to Supreme Headquarters Allied Powers in Europe (SHAPE) as his chief of staff, and in 1953 Gruenther became Supreme Allied Commander in Europe. After he retired in 1956, he became president of the American Red Cross.

H. A. DEWEERD

GRUMMAN, LEROY (1895-), an American industrialist, founded and became chairman of the board of the Grumman Aircraft Corporation. He established the firm in 1929. It produced thousands of military and commercial aircraft. The company began by producing the first fighter plane with retractable landing gear. Later, the parent company and its affiliates also produced boats, canoes, and truck and trailer bodies. Grumman was born at Huntington, N.Y. He served in the U.S. Navy in 1918 and 1919.

ROBERT B. HOTZ

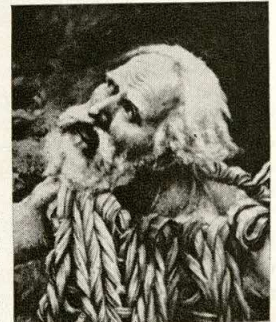
GRUNDTVIG, N. F. S. See **DENMARK** (Education).

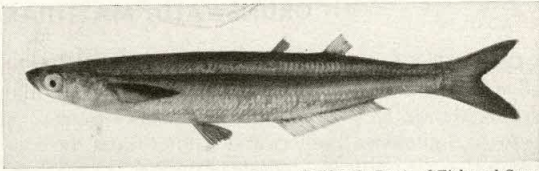
GRUNDY, MRS., is a term that commonly means "gossip." It stands for a section of society with narrow views about proper conduct. The name comes from a play, *Speed the Plow*, written by Thomas Morton in 1798. Dame Ashfield, one of the characters, in fear of being criticized, repeats, "What will Mrs. Grundy say?"

GRÜNEWALD, GRUE *nuh vahlt*, **MATTHIAS** (1475?-1528?), was one of the greatest artists of the German Renaissance. He is known primarily as the painter of the *Isenheim Altarpiece*, one of the world's greatest paintings. It is composed of a number of panels which are hinged together so as to swing open and reveal sculptured figures behind them. These sculptured figures were executed by another artist.

The altarpiece is about 8 feet high. When the panels are closed, the Crucifixion appears on the outside. On the inside panels, Grünewald painted other religious scenes, including *The Nativity*, which appears in color in the **PAINTING** article. Underneath, is the *Pietà*, or lamentation over the dead Christ. The artist was born **MATHIS GOTHART** in the town of Würzburg, Germany. **LESTER D. LONGMAN**

Matthias Grünewald
Historical Pictures Service





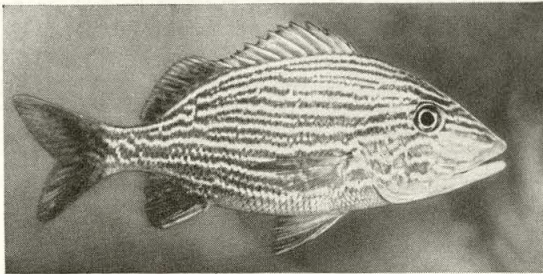
California Dept. of Fish and Game

Grunions come up on the beaches of southern California during the highest tides to spawn and lay their eggs in the sand. People catch the tiny, 5- to 8-inch fish by hand at this time.

GRUNION, *groom* **YOHN**, is a small silvery fish that lives along the Pacific Coast from San Francisco to Lower California. From March to June, thousands of grunion lay their eggs on the sandy beaches. This must be done on nights of the highest tide. Many persons gather on the beaches at this time of year and catch the fish. Newspapers in communities along the coast announce "grunion nights," when the fish may be expected to come up on the beaches. The grunion eggs hatch two weeks after they are laid. As the waves wash the eggs out of the sand, the fish break out of them like bursting popcorn.

Scientific Classification. The grunion belongs to the family *Atherinidae*. It is classified as genus *Leuresthes*, species *tenius*.
LEONARD P. SCHULTZ

GRUNT, or PORKFISH, is an ocean fish that makes grunting sounds when taken from the water. Grunts make up a large family. Many are valuable as food. One



N. Y. Zoological Society

Grunts Weigh About 10 Pounds, and Are Good to Eat.

of the most important food fishes of the American species is the *pigfish*, or *sailor's choice*. The pigfish lives along the Atlantic and Gulf coasts of the United States. It grows a foot long or more, and is light blue above and silvery below, with blue and brown side marks.

Scientific Classification. Grunts belong to the family *Haemulidae*. The pigfish is genus *Orthopristis*, species *chrysopterus*.
LEONARD P. SCHULTZ

See also **FISH** (color picture, Tropical Salt-Water Fishes [Porkfish]).

GUACAMOLE. See **AVOCADO**.

GUADALAJARA, *GWAH tah lah HAH rah* (pop. 377,928), is the second largest city of Mexico, and the capital of the state of Jalisco. The city lies 290 miles northwest of Mexico City, in a wealthy farming and mining region. For location, see **MEXICO** (color map).

The tree-shaded public squares and parks of this beautiful old city date back to the days when Mexico was a Spanish colony. Guadalajara is an important trading and manufacturing center. It has won fame for its fine pottery and blown glass. Other products include

textiles, hosiery, flour, steel, and alcoholic beverages. Several buildings have murals by José Clemente Orozco, a famed painter. The Spaniards founded the city about 1530.

JOHN A. CROW

GUADALCANAL ISLAND lies in the Coral Sea, east of the southern tip of New Guinea. It is the largest island of the British protectorate, the Solomon Islands. It covers about 2,500 square miles. Heavily forested mountains rise as high as 8,000 feet throughout the island. Most of the 14,000 people are Melanesians. The island's chief products include bananas, coconuts, pineapples, rubber, and gold. Honiara, capital of the protectorate, is on Guadalcanal.

Japanese troops occupied Guadalcanal early in World War II. It was the scene of heavy fighting in 1942 and 1943 when United States forces landed and freed the island from Japanese occupation. EDWIN H. BRYAN, JR.

See also **PACIFIC ISLANDS** (Melanesia); **PACIFIC OCEAN** (color map); **SOLOMON ISLANDS**; **WORLD WAR II** (Guadalcanal).

GUADALQUIVIR, *GWAHD 'l KWIV er*, **RIVER** is the deepest river in Spain. It flows southwest through the Andalusian region to the Atlantic Ocean. The river is nearly 400 miles long and is deep enough for large ships for much of its length. The cities of Seville, Córdoba, and Baeza lie along the shores of the Guadalquivir.

GUADALUPE, *GWAH duh LOOP*, **DAY** commemorates the appearance of the Virgin Mary to Juan Diego, a poor Indian. On Dec. 9, 1531, Juan was hurrying across Tepeyac Hill, near Mexico City, when the vision first appeared to him. A lady told Juan to go to the bishop and request that a shrine be built where she stood. It was not until the vision appeared a second time on December 12 and produced a sign, that the bishop believed. During the second appearance, the lady called herself Holy Mary of Guadalupe. Our Lady of Guadalupe became the patron saint of Mexico. Catholics throughout Mexico and in many states in the southwestern United States celebrate her feast day on December 12.

RAYMOND HOYT JAHN

GUADALUPE, *GWAHD 'l oop*, **HIDALGO**, *hih DAL goh*, **TREATY OF.** The United States and Mexico signed an agreement on Feb. 2, 1848, that officially ended the Mexican War. The negotiations were conducted at Guadalupe Hidalgo, a small town near Mexico City.

Under the treaty, the United States obtained the territory that now makes up the states of California, Nevada, and Utah, most of New Mexico and Arizona, and part of Colorado and Wyoming. The two countries agreed upon the Rio Grande as the boundary between Texas and Mexico. In addition, the United States agreed to pay Mexico \$15,000,000, and to assume the payment of all claims held by American citizens against Mexico, provided that all claims had originated before the date of the treaty and did not exceed a grand total of \$3,250,000.

NORMAN A. GRAEBNER

See also **MEXICAN WAR**.

GUADALUPE PEAK. See **MOUNTAIN** (color picture, Mountains of the World); **TEXAS** (Mountains).

GADELOUPE, *GWAHD'l oop*, is a group of seven islands in the West Indies. It forms an overseas department of France within the French Community. The group lies about 300 miles southeast of Puerto Rico. It consists of two main islands and five small islands, and covers 687 square miles. The largest of the two main



The Seven Guadeloupe Islands Lie in the West Indies.

islands is called Guadeloupe, or *Basse-Terre*, and the other is known as *Grande-Terre*. The five small islands are Marie-Galante, Les Saintes, Désirade, Saint Barthélemy, and Saint Martin. The city of Basse-Terre, on Basse-Terre island, is the capital.

Guadeloupe has a population of 228,120. Most of the people are of mixed Negro and white ancestry. The largest all-white community lives on the island of Les Saintes. These people are descendants of the original Norman and Breton settlers. Guadeloupe has a hot, damp climate from May to November. But the trade winds tend to moderate the heat (see *TRADE WIND*). The islands have cool, dry weather from December to April.

Agriculture provides the chief source of income in Guadeloupe. Leading farm products include bananas, cocoa, coffee, and sugar cane. Farmers also grow vegetables and tobacco for local markets. Several distilleries export rum. Guadeloupe's chief port is Pointe-à-Pitre on Grande-Terre island.

A prefect and an elected general council govern Guadeloupe. Three deputies represent the group in the French national assembly. The French established the first settlement in Guadeloupe in 1635. It has been a French possession since that time, except for a series of temporary occupations by the British between 1759 and 1815.

W. L. BURN

See also *BASSE-TERRE*.

GUADIANA RIVER. See *SPAIN (Rivers and Lakes)*.



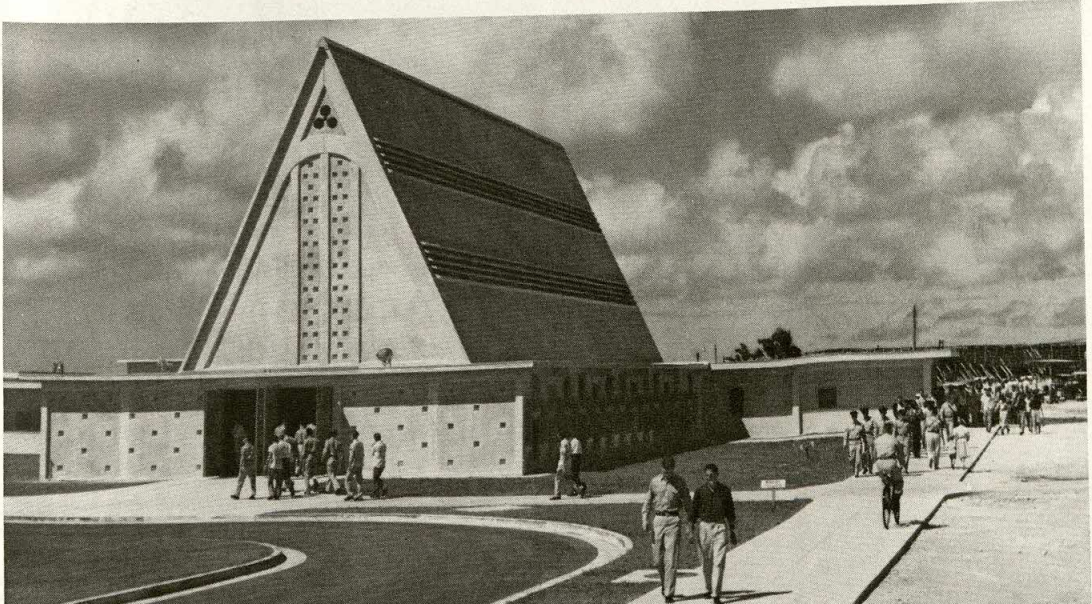
GUAM, *gwahm* (pop. 67,044), is a territory of the United States located in the Mariana Island group. It serves as a vital Pacific Ocean air and naval base. Agana is the capital and Timoneng is the largest city. About 6 out of 10 persons are Guamanians. The rest are military personnel and their dependents.

Location and Size. Guam lies at the south end of the Marianas, about 1,500 miles east of the Philippines. It is about 30 miles long and from 4 to 10 miles wide. Guam covers about 216 square miles.

The Land. Coral reefs lie off the coast of Guam. Mountains rise in the interior. Thick forests once covered nearly the entire northern half of the island, but much of this area has been cleared for farm plots and airfields. The southern half has a range of hills of volcanic origin. Large coconut groves thrive throughout the island. Farmers raise corn, other food crops, and livestock for local use. Apra Harbor is the chief port.

The Chapel at Andersen Air Force Base on Guam is one of the many new buildings erected on the base in the 1950's. Andersen occupies a flat coral plateau on the northern end of Guam.

U.S. Air Force



GUAM

Climate. The people usually enjoy warm, pleasant weather the year around, with temperatures ranging from about 72°F. to 88°F. But earthquakes and tropical storms called typhoons are common. Rainfall averages about 90 inches a year.

The People. Many Guamanians are *Chamorros*, or islanders of Indonesian and Spanish descent. Others are descended from American, Italian, French, British, Japanese, Chinese, Filipino, and Mexican settlers. About 4 out of 10 persons are military personnel and their dependents. Most of the people speak English, but many also speak Chamorro. About 95 out of 100 Guamanians are Roman Catholic.

Cities. Agana (pop. 1,642) is the capital city. Timoneng (5,380), Agana Heights (3,210), Sinajana (2,861), and Mongmong (2,285) are located within the metropolitan area of Agana. Other towns on Guam include New Agat (2,596), Dededo (2,247), Barrigada (1,729), Santa Rita (1,630), and Yona (1,105).

History and Government. The Portuguese explorer Ferdinand Magellan discovered Guam in 1521. Spain made the island a possession in 1561, and ceded it to the United States in 1898 after the Spanish-American War. Japan attacked Guam on Dec. 7, 1941, and captured it five days later. On July 21, 1944, U.S. forces recaptured Guam. The U.S. Navy established its Pacific headquarters there in 1945.

The United States declared Guam a territory on Aug. 1, 1950, and transferred its supervision from the navy to the Department of the Interior. The people became U.S. citizens. They elect a one-house legislature that makes laws for the island. The President of the United States appoints a governor as the chief executive. The governor serves a four-year term, and may be reappointed to office.

In 1954, the United States High Commissioner for the Pacific Islands Trust Territory established his headquarters on Guam. That same year, the Strategic Air Command of the United States Air Force made Guam its Pacific headquarters.

EDWIN H. BRYAN, JR.

See also FLAG (color picture, Flags of the United States and Its Possessions).

GUAN, *gwahn*, is a game bird of tropical America. Some guans are as small as grouse, and others are as large as geese. Their feathers are greenish-black, mixed with white and brown. These birds have long tails, and most species have crests on the head. One species, the *chachalaca*, lives as far north as Texas.

Scientific Classification. Guans belong to the family *Cracidae*. The chachalaca is genus *Ortalis*, species *vetula*.

JOSEPH J. HICKEY

GUANACO, *gwah NAH koh*, is an animal that looks like a camel without a hump. The guanaco and its relative, the vicuña, are the only wild wool-bearing animals of South America. A guanaco stands 3½ to 4 feet high at the shoulder. Its hair is long and thick, reddish-brown above and white below.

Guanacos live on mountains and plains. Domestic llama and alpaca may be descended from the guanaco.

Scientific Classification. The guanaco belongs to the family *Camelidae*. It is genus *Lama*, species *guanacose*.

VICTOR H. CAHALANE

See also ALPACA; ANIMAL (color picture, Central and South America); LLAMA; VICUÑA.

GUANAJUATO, *GWAH nah HWAH toh* (pop. 1,328,712; area 11,805 sq. mi.), is one of the most beautiful states of Mexico. It lies in a mountainous region in the central part of the country. For location, see MEXICO (color map). Farmers raise corn, wheat, peanuts, potatoes, and other crops. The Mexican independence movement began in Guanajuato in 1810. The state capital is the city of Guanajuato. CHARLES C. CUMBERLAND

The White, Sandy Beaches of Guam Provide Recreation and Relaxation Areas for United States Servicemen.

U.S. Air Force





P & A

Millions of Sea Birds Leave Deposits of Guano, a waste matter valuable as fertilizer, on islands off the coast of Peru.

GUANO, *GWAH noh*, is the waste matter of sea birds and bats. It makes a valuable fertilizer because it is rich in nitrate and phosphate. Large colonies of birds such as pelicans, penguins, petrels, cormorants, guanays, and gannets leave immense deposits of this material.

The islands off the coast of Peru have long been the chief source of supply. Deposits on the Chincha Islands at one time covered the surface to a depth of more than 100 feet. Other valuable deposits lie on the Galápagos Islands of Ecuador. Deposits have been found in other parts of Latin America, on the Pacific islands, and in the Grand Canyon Bat Cave in Arizona.

This fertilizer should be mixed with four or five times its bulk of fine soil.

GUANTÁNAMO, *gwahn TAH nah moh* (pop. 42,000), is a city near the south coast of Cuba, about 10 miles inland from Guantánamo Bay. For location, see CUBA (color map). Guantánamo is the center of the Cuban sugar industry. It also serves as a trading and processing center for the agricultural products of the region. The United States maintains a naval base at Guantánamo Bay to help guard the Panama Canal. OTIS P. STARKEY

GUAR, *gwahr*, is a hardy, drought-resistant legume grown for its seeds and forage. The plant, first found in India, was brought to the United States in the early 1900's. It is grown mostly in the Southwest. One variety is a bushy plant which grows about 4 feet high. The special seed-producing type grows somewhat higher. The seeds develop in pods, and contain the chemical com-

pound *mannogalactan*. The chemical is used in the manufacture of paper and in sizing for textiles and paper.

Scientific Classification. Guar belongs to the family *Leguminosae*. It is genus *Cyamopsis*, species *tetragonoloba*.

GUARANÍ INDIANS. See PARAGUAY (Life of the People; Early Days); TUPÍ-GUARANÍ INDIANS.

GUARANTEED ANNUAL WAGE. See LABOR (Union Aims); WAGES AND HOURS.

GUARANTY, *GAR un tih*, is a written agreement whereby one person promises to pay the debt of another in case the latter fails to pay. The *guarantor* is the person who promises to pay. The person in whose interest the promise is made is the *principal*, and the *guarantee* is the person who accepts the promise. The statute of frauds provides that no person shall be liable for the debt, default, or failure of another unless a written agreement so states. If several guarantors promise to pay, each usually must pay his share of the debt. JOHN ALAN APPLEMAN

GUARDIAN, *GAHR dih un*, in law, is a person appointed by a court to care for another person called a *ward*, or for another person's property, or both. A guardian may be appointed for an infant (a person under 21), a spendthrift, an insane or feeble-minded person, or anyone unable to take care of himself. The courts also have the power to remove guardians.

A guardian usually has control of the person, as well as management of the property, of his ward. It is his duty to maintain and educate his ward from the income of the ward's estate. He cannot reap any benefits from his ward's estate, and must account for all profits. He must have a court order before he can buy or sell real estate for his ward's account. He must file an inventory and render accounts before the court for all financial matters.

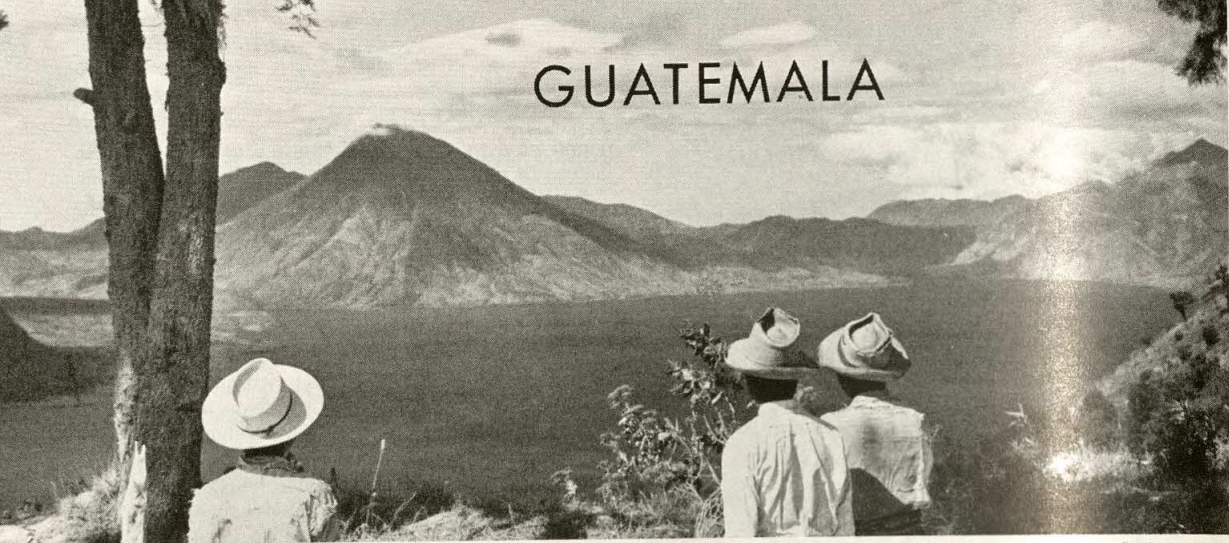
Parents generally act as guardians of their own minor children, and in most states have equal rights of guardianship. In English common law, the father was the sole guardian but this rule has been changed by statute in nearly all parts of the United States and the British Commonwealth of Nations. Because parents become guardians without appointment by a court they are called *guardians by nature* to distinguish them from *guardians by law*. In most states, a child without parents is allowed to choose his own guardian at the age of 14, but the court may reject his choice.

A guardian ad litem is a guardian appointed by a court for the purpose of a single lawsuit. JOHN W. WADE

See also PARENT; RECEIVER; WARD.

GUARNERI, *gwahr NYEH rih*, is the name of a famous family of violinmakers who lived in Cremona, Italy. The first member of the family to win fame for his violins was **Andrea** (1626-1698). He was a fellow student of Stradivari in the workshop of Nicolò Amati, but was not an outstanding craftsman. Andrea's business was carried on after his death by his sons **Pietro** (1655-1728) and **Giuseppe** (1666-1739?). Andrea's nephew, **Giuseppe Antonio** (1687-1745), called "del Gesù," became the most celebrated member of the family. His violins were known for their original design and rich, powerful tone. They were played by Nicolò Paganini, Henri Vieuxtemps, and Eugène Ysaÿe. Guarneri's best models compare well with the best of Stradivari. See also AMATI; STRADIVARI, ANTONIO. DOROTHY DE LAY

GUATEMALA



Gendreau

Guatemala's Clear Blue Mountain Lakes, such as Lake Atitlán, reflect the beauty of many volcanic peaks.

GUATEMALA, *GWAH tay MAH lah*, is the northernmost independent country of Central America. More people live in Guatemala than in any other Central American land. The name of the country in Spanish, the official language, is REPÚBLICA DE GUATEMALA, which means REPUBLIC OF GUATEMALA. The city of Guatemala is the capital and largest city.

Guatemala is almost exactly the same size as Tennessee, but it has only about four fifths as many people as that state. Thick green jungles, purple mountain ranges, and white-topped volcanoes make Guatemala a colorful land. Most of Guatemala's cities lie on cool mountain plateaus that sometimes are shaken by destructive earthquakes. In the cities, most of the people live in low, Spanish-type houses with thick pink or yellow walls and red or brown tile roofs. Many homes have beautiful *patios*, or courtyards. Agriculture ranks as the most important industry of Guatemala, with bananas and coffee as the chief products. Guatemala's thick forests produce the world's finest *chicle*, the main raw material in chewing gum.

The copper-colored faces and bright costumes of Guatemala's Indians are a familiar sight along the mountain trails and in the crowded market towns.

Their Mayan ancestors built great palaces, temples, and cities more than 1,500 years ago. The ruins

of the early Mayan civilization lie on the plains of eastern Guatemala. Today, the Indians live in small villages of thatched huts in fertile green valleys, or near blue mountain lakes.

The Land and Its Resources

Location, Size, and Surface Features. Guatemala is bordered on the north and west by Mexico. The Pacific Ocean and El Salvador lie to the south. The *Color Map* shows that British Honduras, the Gulf of Honduras, and Honduras are east of Guatemala. Guatemala covers 42,042 square miles.

Mountains. The mighty Sierra Madre mountain range and its smaller branches cover almost two thirds of Guatemala. Several peaks rise more than 12,000 feet. Tajumulco (13,816 feet), in southwestern Guatemala, is the highest mountain in Central America. Guatemala has 27 volcanoes, some of them still active. The earth-

FACTS IN BRIEF

Type of Government: Republic.

Capital: Guatemala.

Divisions: 22 departments divided into municipalities.

President: Elected for a 6-year term by the people.

National Assembly: One house, 66 deputies, elected for four-year terms by direct popular vote.

Area: 42,042 square miles. **Greatest distance:** (north-south) 290 miles; (east-west) 255 miles. **Pacific coast line,** about 200 miles. **Caribbean coast line,** about 70 miles.

Elevation: *Highest,* Tajumulco Peak, 13,816 feet; *lowest,* sea level.

Population: 2,788,122. **Density,** about 66 persons to the square mile. **Distribution,** rural, 69 per cent; urban, 31 per cent.

Chief Products: *Agriculture,* abacá, bananas, beans, coffee, corn, cotton, perfume oils, rice, rubber, sugar, wheat. *Forest Industry,* chicle, cinchona bark, lumber. *Manufacturing and Processing,* furniture, leather goods, soap, textiles.

Flag: The flag has a vertical blue stripe at each end and a white stripe bearing the coat of arms in the middle. See FLAG (color picture, Flags of the Americas).

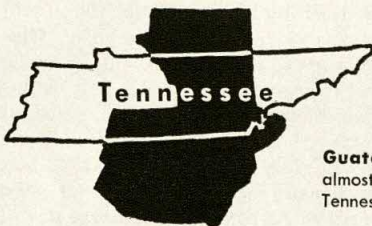
National Holiday: Independence Day, September 15.

National Anthem: "Himno de Guatemala" ("Anthem of Guatemala").

Money: *Basic unit,* Quetzal. For its value in dollars, see MONEY (table, Values).



Location Map of Guatemala (shown in black)



Guatemala (in black) is almost the same size as Tennessee.



Especially created for World Book Encyclopedia by Rand McNally and World Book editors

GUATEMALA

Departments

ALTA VERAPAZ,	C 3
BAJA VERAPAZ,	C 3
CHIMALTENANGO,	D 2
CHIQUEMULA,	D 4
EL PETÉN,	B 3

EL PROGRESO,	D 3
EL QUICHÉ,	C 3
ESCUINTLA,	D 3
GUATEMALA,	D 3
HUEHUETENANGO,	C 2
IZABEL,	C 5
JALAPA,	D 3
JUTIAPA,	D 4
QUEZALTENANGO,	D 2
RETALHULEU,	D 2

SACATEPÉQUEZ,	D 3
SAN MARCOS,	C 2
SANTA ROSA,	D 3
SOLOLÁ,	D 2
SUCHITEPÉQUEZ,	D 2
TOTONICAPÁN,	D 2
ZACAPA,	C 4

Cities

Antigua,	D 3
Chimaltenango,	D 3
Chiquimula,	D 4
Cobán,	C 3
Cuilapa,	D 3
El Progreso,	D 3
Escuintla,	D 3
Flores,	B 4
Guatemala,	D 3
Huehuetenango,	C 2

Izabal,	C 4
Jalapa,	D 4
Jutiapa,	D 4
Mazatenango,	D 2
Quezaltenango,	D 2
Quiché,	C 2
Retalhuleu,	D 2
Salamá,	C 3
San Marcos,	D 2
Sololá,	D 2
Totonicapán,	D 2
Zacapa,	D 4

Source: Latest available figures.



Screen Traveler, Gendreau

Guatemala's Indian Women cover their heads with brightly colored shawls which they weave on crude hand looms.

quakes that hit the mountain areas sometimes cause much damage and loss of life.

Plains. A dense jungle covers the vast, flat plain of northern Guatemala. Narrow lowland plains lie along Guatemala's two sea coasts. These are regions of thick tropical forest and fertile soil.

Rivers and Lakes. The Motagua River is Guatemala's longest. It rises in the mountains and flows 250 miles eastward to the Gulf of Honduras. The Usumacinta River forms part of the Mexican border. The 150-mile-long Polochic River flows into Lake Izabal, Guatemala's largest lake. The navigable Dulce River connects Lake Izabal with the Gulf of Honduras. Atitlán and Amatitlán, two beautiful lakes, lie near the city of Guatemala.

Natural Resources. Guatemala's rich soil is its most important natural resource. Mahogany, cedar, cypress, pine, and sapodilla trees grow in the forests. Small amounts of chromite, zinc, lead, gold, silver, manganese, mica, and salt are mined.

Climate. Temperatures in Guatemala range from the tropical heat of the plains to the cold of the mountain peaks. Temperatures at the capital range between 45°F. and 85°F., and the city's average annual rainfall is about 52 inches. Some lowland areas receive as much as 200 inches of rain a year.

The People and Their Work

The People. About 55 of every 100 persons in Guatemala are pure-blooded Indians. They are descendants of the ancient Mayan Indians (see MAYA). The rest of

the people are mostly *Ladinos*, of mixed Spanish and Indian blood. There also is a small group of white people of Spanish descent. The people of Guatemala are called *Guatemaltecos*.

Way of Life. Most of the people live on farms or in small villages on the mountain plateaus or valleys of western Guatemala. Almost all the Indians make their homes in rural villages. The *Ladinos* usually live in cities or towns. Most of the people are poor, and few own their own farms. In 1956, the government began selling small plots of government-owned land to the farmers in an effort to improve their living standard.

The Indians follow some of the customs of their Mayan ancestors. Most Indian villages have witch doctors who try to cure illness, foretell the future, and protect the people from evil gods.

Indian women wear *huipiles*, or loose blouses, and long, tightly wrapped skirts. The men wear loose shirts and tight trousers with slit sides. Most *Ladinos* wear American-style clothes. See also CLOTHING (color picture, Latin America).

The people eat many foods made of rice, beans, and meat. They eat the roots of the sweet cassava plant instead of potatoes (see CASSAVA).

Guatemaltecos celebrate many *fiestas*, or holidays, with gay, colorful dances. One of the most famous dances is *La Conquista* (The Conquest). In *La Conquista*, dancers wear wooden masks and red wigs. They act out the conquest of Guatemala by the Spanish soldier Pedro de Alvarado. The dancers wear red wigs because Alvarado had red hair.

Cities. Guatemala is the capital and chief city of the country. Quetzaltenango, an important commercial center, is the second largest city. Antigua Guatemala, now called Antigua, served as Guatemala's capital during colonial days. See ANTIGUA; GUATEMALA; QUEZALTENANGO.

Agriculture. About 70 out of every 100 persons in Guatemala earn their living by farming. Coffee and bananas are Guatemala's chief agricultural products and leading exports. Guatemala ranks seventh among the coffee-growing countries of the world, and is one of the world's largest banana-growing countries. Farmers also raise beans, cassava, corn, and rice. Other agricultural products include cotton, oils, rubber, and sugar.

Forest Products. The forests of northern Guatemala provide the world's best chicle (see CHICLE). The forests also furnish excellent lumber and cinchona bark. Cinchona bark is the source of the drug quinine.

Manufacturing. Guatemala has no large-scale manufacturing. Products made mostly for local use include textiles, leather goods, furniture, and soap.

Exports and Imports. Coffee ranks as Guatemala's chief export. Other leading exports are bananas and chicle. Guatemala's imports include machinery, textiles, petroleum, iron and steel products, and clothing. Most of the trade is with the United States.

Transportation and Communication. About 4,200 miles of highways, mostly unpaved, cross Guatemala. The Pan American Highway winds through Guatemala from the Mexican border to El Salvador. About 800 miles of railways connect the capital, Guatemala, with ports on both coasts, and with Mexico and El



Screen Traveler, Gendreau

Market Day is a Busy Time in Guatemalan Towns. The Indians gather in market places, such as this one in Chichicastenango, near Quiché. They meet to trade their goods and exchange gossip. Guatemala's Indians sometimes worship by kneeling on the steps of Roman Catholic churches and burning incense.

Salvador. Rivers, especially the Usumacinta and Polochic, also are used for transportation. Many international shipping and airlines serve Guatemala. Telephone and telegraph lines connect the major cities. Guatemala has radio and television stations.

Social and Cultural Achievements

Education. Public school education is free in Guatemala. The law requires all children between the ages of 7 and 14 to go to school. However, many children do not attend, because of a shortage of classrooms and teachers. About 65 of every 100 persons in Guatemala cannot read or write. The government-supported University of San Carlos, founded in 1678, is in the capital.

Religion. Guatemala has complete religious freedom. The Roman Catholic Church has by far the largest number of members. Many Indians combine Catholicism with the worship of ancient gods and idols.

The Arts. Guatemala's Indians are famed for their weaving. The women of each Indian village weave

cloth that is different in color and pattern from the cloth of any other village.

Guatemala's most famous painter is Carlos Mérida (1893-). He is best known for his water colors based on the art of the ancient Mayan Indians. Guatemala has produced a few well-known writers. They include the romantic poet José Batres Montúfar (1809-1844), the historical novelist José Milla (1822-1844), and the poet and novelist Rafael Arévalo Martínez (1884-).

The *marimba*, a type of xylophone, is popular in Guatemala. Marimba bands play classical and popular music throughout the country.

Government

National Government. The president of Guatemala heads the Government. He is elected for a six-year term by direct popular vote. According to the constitution, the president cannot be re-elected for 12 years following the end of one term. Actually, however, many of Guatemala's presidents have been dictators who stayed in office for more than six years. The people choose the 66 deputies of the National Assembly by direct popular vote. Each deputy represents about 50,000 persons. All men and women over 18 may vote, and all men and women over 18 who can read and write must vote.

Guatemala's political parties include the National Democratic Movement, the National Anti-Communist Front, and the Christian Democrat.

Local Government. Each of Guatemala's 22 departments is headed by a governor. The president appoints governors for indefinite terms. The people elect mayors and councils of the municipalities.

History

Early Days. The first of two Mayan Indian civilizations flourished in Guatemala from about A.D. 300 to 800. A new Maya civilization developed early in the 900's. Hernando Cortes (1485-1547), the Spanish conqueror of Mexico, sent Pedro de Alvarado (1485?-1541) to Guatemala in 1523. After a hard struggle, Alvarado defeated the Indians. He established the Spanish colony of Guatemala in 1524. Guatemala's gold attracted the Spaniards to the country. But the gold supply was soon exhausted, and the colony became agricultural.

Independence. In 1821, all the Central American Spanish colonies declared their independence from Spain and later joined the Mexican Empire. The colonies withdrew from Mexico in 1823, and formed the Republic of the United States of Central America. The organization broke up in 1838. Guatemala became an independent republic in April, 1839.

Dictatorship and Progress. Rafael Carrera (1814-1865) was the first of Guatemala's many dictators. He controlled the country from 1838 until his death in 1865. He was elected president in 1843, again in 1851, and was made president for life in 1854.

In 1873, Justo Rufino Barrios (1835-1885) was elected president. Barrios ruled as a dictator for 12 years. During his presidency, Guatemala's first railroad was completed and other improvements were made.

President José María Reina Barrios (1853-1898), Rufino Barrios' nephew, was assassinated in 1898, and Manuel Estrada Cabrera (1857-1924) came to power. He ruled the country with an iron hand until the people drove him into exile in 1920. During this period,

Guatemala's coffee industry and its United States-owned banana industry began to prosper.

Guatemala's next dictator was General Jorge Ubico Castañeda (1878-1946). He was elected president in 1931 and ruled the country until 1944. Ubico's government reduced Guatemala's debts and improved the country's economic condition. However, the people had little political freedom. In 1944, they forced Ubico to resign. Guatemala declared war on Germany, Italy, and Japan during World War II, and became a charter member of the United Nations in 1945.

Juan José Arévalo (1904-) was elected president in 1944. His government improved education, encouraged the organization of labor unions, and built hospitals and other projects. During this period, Guatemala unsuccessfully renewed its old claim to British Honduras (see BRITISH HONDURAS [History]).

Recent Developments. Guatemala elected Jacobo Arbenz Guzmán (1913-) president in 1950. The Arbenz government was backed by the Communists in Guatemala. It seized land from the large plantations and gave the land to small farmers. Guatemala had few Communists, but they held important positions in the government and controlled the labor unions.

In June, 1954, an anti-Communist Guatemalan army, led by Colonel Carlos Castillo Armas (1914-1957), invaded Guatemala from Honduras. After a brief war, Arbenz resigned. The anti-Communist leaders took control of the government. They appointed Castillo Armas president. In October, 1954, the people approved a six-year presidential term for Castillo Armas. His government began selling government-owned land to the people. Land taken by Arbenz was returned.

A new constitution outlawing the Communist party went into effect in 1956. But, in 1957, a Communist assassinated Armas. Vice-President Luis Gonzalez Lopez formed a provisional government. In October, Guillermo Flores Avendaño became president of Guatemala. In 1958, Miguel Ydígoras Fuentes was elected president of Guatemala.

CHARLES C. CUMBERLAND

Related Articles in WORLD BOOK include:

Abacá	Central	Marimba
Alvarado, Pedro de	America	Maya
Antigua Guatemala	Chicle	Quetzal
Banana	Coffee	Quezaltenango
Barrios, Justo R.	Guatemala	Valle, José C. del

Outline

- I. The Land and Its Resources
 - A. Location, Size, and Surface Features
 - B. Natural Resources
 - C. Climate
- II. The People and Their Work
 - A. The People
 - B. Way of Life
 - C. Cities
 - D. Agriculture
 - E. Forest Products
 - F. Manufacturing
 - G. Exports and Imports
 - H. Transportation and Communication
- III. Social and Cultural Achievements
 - A. Education
 - B. Religion
 - C. The Arts
- IV. Government
- V. History

Questions

How does Guatemala compare with your state or province in area and population?

Who are *ladinos*?

Why do dancers wear red wigs in *La Conquista*?

What are the chief products of Guatemala?

How did anti-Communists gain power in 1954?

GUELDER-ROSE

GUATEMALA, or **GUATEMALA LA NUEVA**, sometimes called **SANTIAGO DE GUATEMALA** (pop. 284,922; alt. 4,850 ft.), is the capital and largest city of Guatemala. It lies on a plateau, about 75 miles from the Pacific Ocean. The city was founded in 1776, when the Spanish government moved the colonial capital there. An earthquake had destroyed the previous capital, now called Antigua. For location see **GUATEMALA** (color map).

CHARLES C. CUMBERLAND

GUAVA, *GWAH vuh*, is a red or yellow fruit. It is round or pear-shaped and about the size of a hen's egg.

This fleshy fruit contains many hard seeds. The flesh is grainy like that of a pear, with a musky odor and flavor. In many tropical countries it is a popular dessert. It is also made into jelly.

The fruit grows on shrubs or small trees that belong to the myrtle family. The plants bear attractive small white flowers. They are easily grown from seed, but certain kinds may be grafted or budded. The plants bear fruit when they become two or three years old. The common guava grows abundantly in Florida and other parts of tropical America. In California, the fruit is called the *lemon guava*. The *strawberry guava* grows in Brazil.

Scientific Classification. The guava belongs to the family *Myrtaceae*. The common guava is genus *Psidium*, species *guajava*. The strawberry guava is *P. cattleianum*. JULIAN C. CRANE

See also **PLANT** (color picture, Fruits Unknown to Our Forefathers).

GUAYAQUIL, *GWAH YAH KEEL* (pop. 258,966; alt. 30 ft.), is the largest city in Ecuador, and the country's principal seaport. It lies on the west bank of the Guayas River, 40 miles from the Pacific Ocean. Sea-going ships stop at Puná, an island in the Gulf of Guayaquil. Small river craft operate between Puná and the city. For location see **ECUADOR** (color map).

Guayaquil has sawmills, breweries, ironworks, cotton mills, and small shipyards. The Spanish founded the city in 1537. The cathedral dates back to Spanish days. The city's Municipal Palace is a handsome public building.

C. LANGDON WHITE

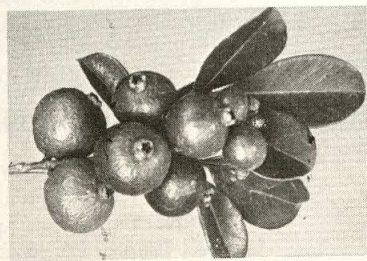
GUAYULE, *gwah YOO lay*, is an unattractive, coarse shrub that grows in the northern Mexican desert. The grayish-green plant grows 2 to 3 feet high. Guayule produces and stores liquid latex during its 10 years of growth (see **LATEX**). The Aztec Indians once made crude footballs from the hardened liquid of the guayule shrub.

The United States government has sponsored experimental guayule farms in California, Texas, and Arizona.

Scientific Classification. Guayule belongs to the family *Compositae*. It is classified as genus *Parthenium*, species *argentatum*. J. J. LEVISON

GUDRUN. See **SIEGFRIED**.

GUELDER-ROSE. See **SNOWBALL**.



Armstrong Nurseries
Guavas

GUELPHS AND GIBELLINES

GUELPHS, *gwelfs*, **AND GIBELLINES**, *GIB uh linz*, were two political groups in Italy during the late Middle Ages. *Guelph* is the Italian form of the German family name *Welf*. It was the Welf family that held the duchies of Bavaria and Saxony in the 1300's. Ghibelline is said to have come from *Waiblingen*, the name of an estate of the Hohenstaufen family.

The contest of these two families for the throne of Germany began the strife between the two Italian parties. The Ghibellines favored the imperial cause, and the Guelphs supported the Pope.

Later, the Hohenstaufen family was wiped out and the two names lost their original meaning. By tradition, certain towns were Guelph and others Ghibelline. If the ruling authorities in any town took one name, the opposition usually took the other. WILLIAM F. McDONALD

GUERICKE, OTTO VON. See **BAROMETER**.

GUERIN, JULES. See **LANDSCAPE GARDENING**.

GUERNICA. See **PICASSO, PABLO**.

GUERNSEY. See **CATTLE** (Dairy Cattle; color picture).

GUERNSEY (pop. 45,474) is the westernmost of the Channel Islands. For location, see **CHANNEL ISLANDS**. Much of its area of 25 square miles is covered with farms and flower gardens, some of which are under glass. Tomato growing is an important industry on the island. Sleek tan-and-white Guernsey cattle graze in the fields. The capital of Guernsey, St. Peter Port, has a deep, hill-bordered harbor. FREDERICK G. MARCHAM

GUERRERO, *geh RAY roh* (pop. 919,386; area 24,887 sq. mi.), a state of Mexico, has some of the steepest mountains in the country. It lies along Mexico's south Pacific Coast. For location, see **MEXICO** (color map). Farmers grow rice, corn, peanuts, and other crops. Acapulco, an important port, and Taxco are tourist centers. Guerrero became a state in 1849. Chilpancingo is the capital of the state of Guerrero. See also **ACAPULCO**; **TAXCO**. CHARLES C. CUMBERLAND

GUERRERO, MANUEL AMADOR. See **PANAMA** (Independence).

GUERRILLA, *guh RILL uh*, is a person who engages in irregular fighting during wartime. He or she is not usually in uniform and is not a member of a formal military force. Guerrillas normally use hit-and-run methods and operate behind enemy lines. They may be organized, but usually fight as informal bands. They are sometimes called *underground* or *resistance* fighters or *partisans*. The name *guerrilla* was first used during the wars of Napoleon in the 1800's. It is a Spanish word meaning *little war*.

Methods of warfare once demanded formal battle formations, but General Francis Marion used guerrilla tactics in the Revolutionary War. CHARLES B. MACDONALD

See also **FIFTH COLUMN**; **PARTISANS**; **UNDERGROUND**.

GUEST, EDGAR ALBERT (1881-1959), an English-born American poet, wrote about friendship, family affection, the home, and similar subjects. One of his famous lines is "It takes a heap o' living to make a house a home." Guest was born in Birmingham, England, and came to the United States as a boy. He attended public schools in Detroit, Mich., and began to work for the *Detroit Free Press* in 1895. His works include two poetry collections, *A Heap o' Living* (1916) and *Life's Highway* (1933). WILLIAM VAN O'CONNOR

GUGGENHEIM, *GOOG un hime*, is the name of an American family of industrialists and philanthropists. The father, Meyer Guggenheim, built up a fortune in mining and smelting. His sons increased the family wealth and used much of it to promote education.

Meyer Guggenheim (1828-1905) came to the United States at 19. He prospered as an importer of Swiss embroidery in Philadelphia. In 1887, his career took a sudden turn when friends interested him in copper mining in Colorado. Guggenheim built a copper smelter at Pueblo, Colo., in 1888, and gradually put his entire fortune into mining ventures. In 1901, he won a two-year battle with the American Smelting and Refining Company, the leading company of the industry, and took control of that firm. He was born in Switzerland.

Daniel Guggenheim (1856-1930) followed his father as head of the family copper interests. He guided the American Smelting and Refining Company as either president or chairman of the board from 1901 to 1919. He also took over gold mines in Alaska, tin and nitrate mines in South America, and rubber plantations in Africa. In 1924, he set up the Daniel and Florence Guggenheim Foundation to promote "the well-being of mankind." He also established the School of Aeronautics at New York University and the Daniel Guggenheim Foundation for the Promotion of Aeronautics. He was born in Philadelphia.

Murry Guggenheim (1858-1939), another of Meyer Guggenheim's sons, was in charge of the Pueblo smelter and helped obtain mining concessions in Mexico. In 1929, he founded the Murry and Leonie Guggenheim Foundation in New York City, which set up free dental clinics. He was born in Philadelphia.

Simon Guggenheim
United Press Int.



Simon Guggenheim (1867-1941), a third son of Meyer Guggenheim, served as United States Senator from Colorado from 1907 to 1913. He became president of the American Smelting and Refining Company in 1919. He established the John Simon Guggenheim Memorial Foundation in 1925 in memory of his son. He was born in Philadelphia. ROBERT H. BREMER

GUGGENHEIM MEMORIAL FOUNDATION, THE JOHN SIMON, offers fellowships to scholars in all fields of knowledge and the arts. The financial assistance gives them the opportunity to further their work. Senator and Mrs. Simon Guggenheim of Colorado gave \$3,000,000 to set up the foundation in 1925, in memory of their son, John Simon.

The foundation corporation has assets of about \$45,000,000. It grants fellowships to citizens and permanent residents of the United States; to Canadians, under its Canadian fellowship plan; to Puerto Ricans, and to citizens of all the Latin-American republics; and to citizens of the Philippines.

A selection committee determines the merit of candidates for fellowships. Each person who applies must present a plan for exploring some facet of knowledge or for producing a particular work in the arts. Appoint-

ments are generally made for one year, and the needs of the individual determine the amount of the grant. Foundation headquarters are at 551 Fifth Avenue, New York 17, New York.

See also FELLOWSHIP; GUGGENHEIM.

GUGGENHEIM MUSEUM houses an important collection of works of art by recent and contemporary painters, sculptors, and other artists. Frank Lloyd Wright designed the building, which faces Fifth Avenue between 88th and 89th streets in New York City. It is the only building in New York City designed by Wright. The museum was founded in 1937 by Solomon R. Guggenheim to promote art and education in art. It is controlled by the Solomon R. Guggenheim Foundation.

See also WRIGHT, FRANK LLOYD.

GUIANA, *gee AH nuh*, is the name of three regions on the northeast coast of South America. Each region is controlled by a European country.

See BRITISH GUIANA; FRENCH GUIANA; SURINAM.

GUIANA HIGHLANDS. See SOUTH AMERICA (Land Regions).

GUIDANCE is the process of helping persons make the best possible decisions about their lives, and aiding them in solving their problems. It includes helping students choose the proper courses to take in school, and aiding them in deciding what careers to follow after their education is completed. Such decisions require that a person have full and correct knowledge about himself and his world. A person must know the facts about himself, the kind of person he is, and the kinds of talents he has. He also must understand how social and economic conditions may affect his decisions. Guidance aims to provide a person with this information so that he may make the best possible decisions in life.

Guidance has become an important part of school programs. Helping students decide what courses they should take and what extracurricular activities best fit their needs is usually called *educational guidance*. Schools also conduct much *vocational guidance* that aims to help students make the best career choices. In some schools, teachers and principals furnish guidance. Other schools have specially trained *counselors* who devote most of their time to guidance activities. Many schools have *guidance directors* who serve to coordinate guidance activities.

Educational Guidance usually starts with helping students decide what courses they should take, or what kind of curriculum they should follow. This is often a complicated decision for high-school students to make. Large high schools usually offer a wide range of courses for a student to choose from. Also, a student must decide whether to take a course of study that will prepare him for college, or one that will make him able to get and hold a job after high-school graduation. When a student decides to take a certain course of study, he may also be deciding how he will spend his life. For example, a student who decides to take an industrial course rather than a college preparatory course, is usually deciding that he does not want to be a doctor, a lawyer, an engineer, or a teacher.

The choice of courses to take in school also depends on other factors. Some students do not have the abilities or interests that will enable them to succeed in every course a school has to offer. Each course differs from



Chicago Public Schools

Teachers and Parents Provide Guidance to help children work out the problems that arise at school and at home.

every other course and makes different demands on the student.

Educational guidance uses two main methods to help students make decisions and solve problems. These are counseling and testing.

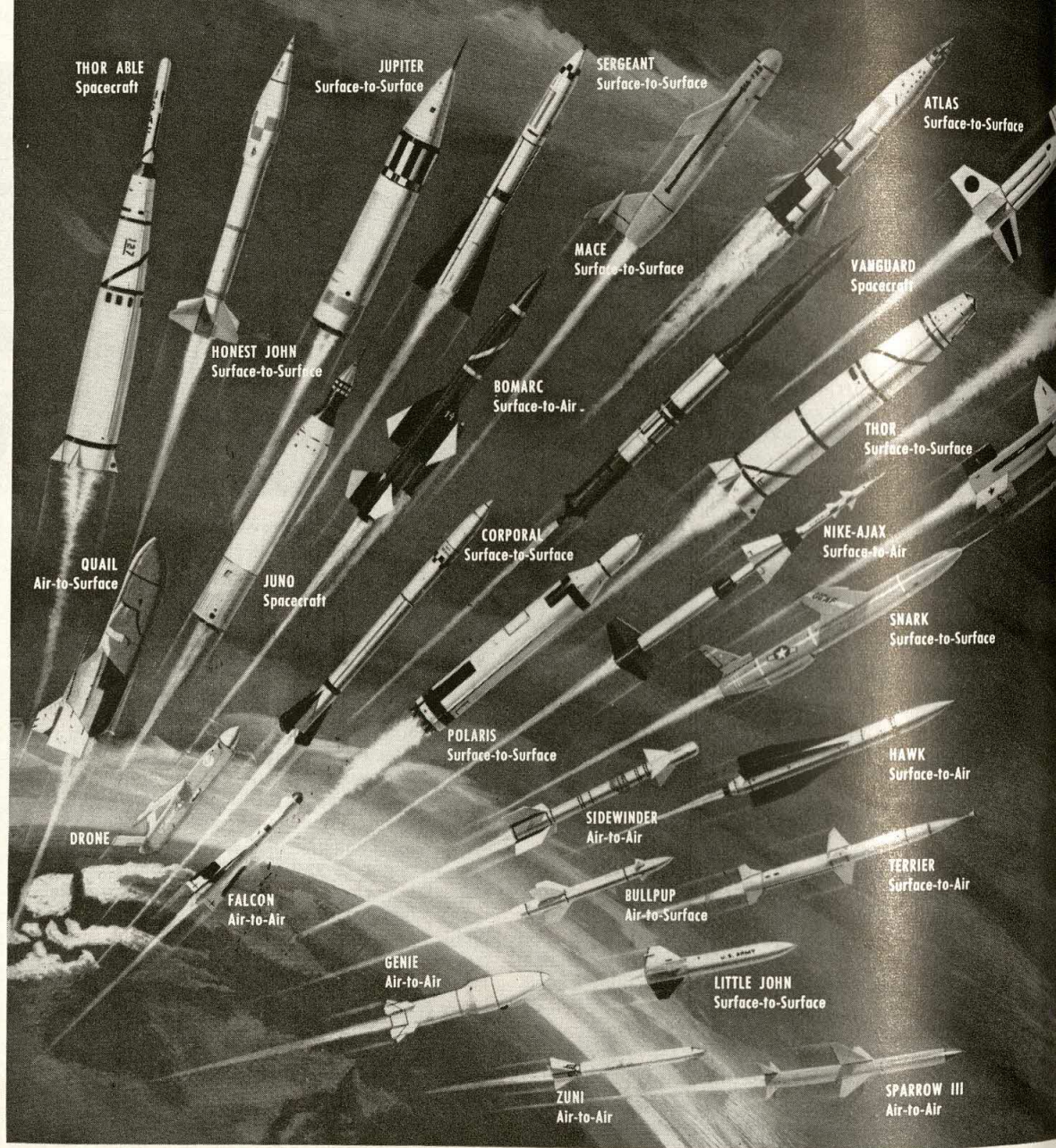
Counseling consists chiefly of discussions between a student and his principal, teacher, or a special counselor. By discussing his problem with a counselor, the student discovers information about himself that will aid him in making his decisions. Generally, there are two kinds of counseling—directive and nondirective. In *directive* counseling, the counselor takes an active part in the conversation between himself and the student. Using information he has gathered from the student's school records, he helps the student discover his problems and suggests possible solutions. A *nondirective* counselor takes a less active role in the conversation. He usually lets the student do most of the talking, and rarely suggests solutions. Generally, nondirective counselors believe most persons can solve their own problems if they talk about them to a sympathetic listener. Directive counselors work on the theory that some persons do not have the ability to solve their own problems.

Testing is an important guidance tool. Aptitude, personality, and intelligence tests help counselors discover information that cannot be obtained in other ways. Tests do not provide a solution to problems, but merely serve as an aid to counseling. Aptitude tests are especially useful when given and explained by trained experts. See TESTS AND MEASUREMENTS.

Other Guidance Aids include books, pamphlets, motion pictures, and lectures aimed to help students decide on courses of study and future careers. Some schools give courses in educational guidance.

Vocational Guidance is closely related to educational guidance, and uses many of the same methods. However, vocational guidance is more directly concerned with a student's choice of a future career. It aims to help a person decide what jobs best fit his abilities and interests, and to make him aware of the opportunities and training required for success in each vocation. See VOCATIONAL GUIDANCE.

WILLIAM H. NAULT



The U.S. Guided Missile Arsenal contains a mighty array of weapons. It includes drones used for target practice and giant ballistic missiles capable of soaring thousands of miles.

GUIDED MISSILE. Imagine a streamlined tube with stubby wings shorter than your arms. Put in an electronic brain so it can follow orders and solve problems for itself. Give it electronic eyes to see its target. Fill its nose with explosives. Add a rocket or jet engine that can send it racing through the sky without a pilot aboard at a speed of more than 9,200 miles an hour. This is a *guided missile*.

Because this amazing weapon can "think" and see for itself, as well as fly, it is like a mechanical bird. That is why *missilemen*, the men who build, launch, and control guided missiles, refer to them as *birds*.

These birds are being hatched in the greatest secrecy, in closely guarded factories, laboratories, and proving

grounds of all the world's major countries. The size, speed, and range of the latest types of guided missiles are military secrets.

Aircraft designers and builders believe that guided missiles some day will take the place of military fighter and bomber planes in war. This is because (1) guided missiles will do away with the danger to highly trained airmen flying over enemy territory; (2) they are more likely to hit their targets than are bombs or guns fired from airplanes; and (3) they are much cheaper than airplanes because they can be built to make one flight only, and require no space for a pilot and crew. Missile scientists also believe that it may some day be possible to speed mail, freight, and possibly even passengers

GUIDED MISSILE

across oceans and continents in rocket-propelled, missile-type vehicles.

Kinds of Guided Missiles

The United States armed services have developed more than 50 different guided missiles. These can be grouped several ways, including (1) by the use of the missile and (2) by the kind of guidance system used to steer the missile to its target. Most missiles can also be divided into ballistic or nonballistic missiles.

By Use. All guided missiles can be divided into four simple groups depending on how they will be used. These are (1) surface-to-surface, (2) surface-to-air, (3) air-to-air, and (4) air-to-surface.

Surface-to-Surface Missiles are launched from the ground or ships at surface targets. For example, the U.S. Air Force sends its *Matador* missiles aloft from mobile ground launchers. A jet engine propels the missile to targets as far as 700 miles away. In the U.S. Navy, such missiles are called *ship-to-surface*, *ship-to-ship*, and *ship-to-shore*. Some surface-to-surface missiles have liquid- or solid-fuel rocket engines.

Surface-to-Air Missiles are launched from the ground or ships at enemy aircraft and missiles. In the navy, they are called *ship-to-air* missiles. Examples of these missiles include the U.S. Navy's *Terrier* and the U.S. Army's *Nike-Hercules*. Both have solid-fuel rocket engines.

Air-to-Air Missiles are launched from fighter airplanes against enemy aircraft. An example of these missiles is the *Sidewinder* used by both the air force and navy. All such missiles are solid-fuel rockets.

Air-to-Surface Missiles are launched from aircraft at ground targets or ships. Examples of these missiles include the air force's *Hound Dog* and the navy's *Bullpup*. These missiles have jet or solid-fuel rocket engines.

In addition, the navy also has a *surface-to-underwater* missile called the *Rat*. This is a rocket-propelled torpedo that can be launched from either ships or airplanes. A parachute eases the missile into the water and it then seeks out and destroys enemy submarines.

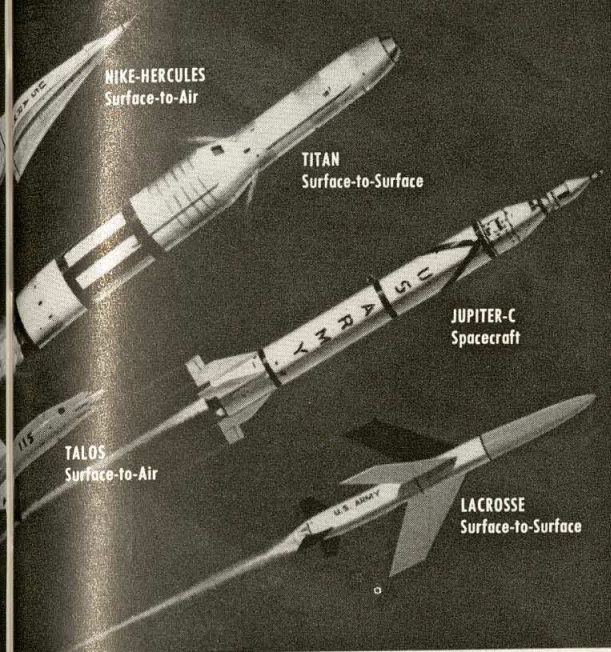
By Guidance System. Missiles may have one of several kinds of guidance systems. These include (1) command, (2) homing, (3) beam riding, and (4) pre-set.

Command system means the missile can be controlled by radar or other means after it has been launched. The *Nike-Hercules* is a radar-command missile.

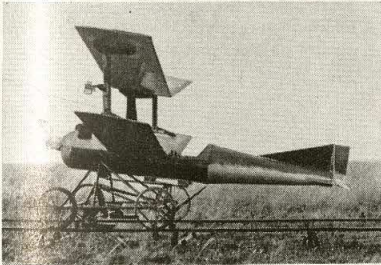
Homing means the missile has a guidance system that detects the target and automatically steers the missile to it. The navy's *Sparrow* is equipped with a radar-homing device. The *Sidewinder* has an infrared homing system that detects heat waves given off by the target. The *Rat* uses an *acoustical* homing device that tracks submarines by the sounds they make.

Beam-Riding missiles are usually guided by following a radar beam. For example, the *Terrier* follows a ship-based radar beam to a target.

Pre-set guidance means a predetermined path is put into the missile's control system before it is launched. Long-range, surface-to-surface missiles often have pre-set systems. **Inertial** guidance systems are a special type of pre-set system. They include gyroscopes, computers, and devices called *accelerometers* that detect changes in velocity. Inertial guidance systems are completely self-



Remsen Advertising Agency



U.S. Air Force

An Explosives-Filled Airplane, one of the earliest guided missiles, was developed in World War I, but was not used in combat.

Sizes of Guided Missiles range from the Falcon, below, one of the smallest, to the 75-foot-long Atlas, right, one of the largest.

U.S. Air Force; Look Magazine



GUIDED MISSILE

Electronic "Brains" and "Eyes" Replace Human Pilots in Birds of War

MAIN PARTS

Antennae receive information from ground by radar or radio to control flight to target.

Control Surfaces, like the ailerons, elevators, and rudder of an airplane, change the direction of flight.

Explosive Warhead destroys the target.

Antenna acts as an "eye" to gather information from the target by radar, television, heat, or other means.

Booster Rocket sends missile roaring off the ground. It drops off when jet engine begins running at high speed.

Jet Engine provides power to carry missile through sky at speed faster than sound.

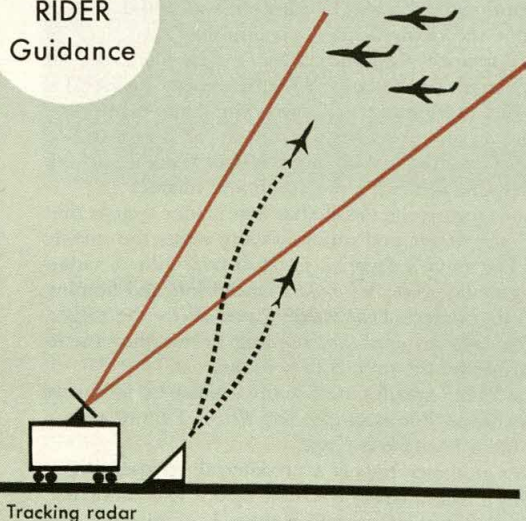
Airframe, like an airplane's fuselage, is a strong framework covered with metal skin.

Electronic "Brain," or computer, uses information received by antennae to move control surfaces and steer missile.

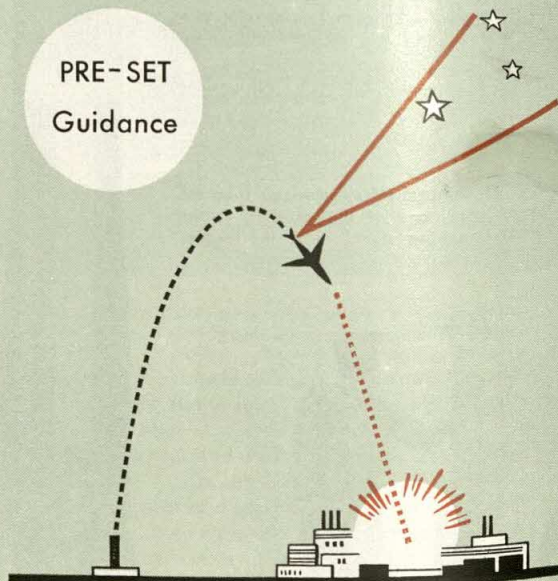
How Missiles Are Guided

Electronic brains used in guided missiles receive information to guide them to their targets by four main guidance systems, or by a combination of the four: (1) Beam Rider, (2) Pre-set, (3) Command, and (4) Homing.

BEAM RIDER Guidance



PRE-SET Guidance



This system is designed mainly for defense against enemy planes or missiles. Ground radar, like a narrow searchlight beam, points at an enemy plane. A missile is launched which flies along the beam until it collides with its target. The brain in the missile continuously looks back at the radar to keep the missile on the beam. Several missiles can be sent along the beam, one after another.

Missile is designed to destroy enemy ground targets a long distance away. Before the missile is launched, it is set to fly to a certain target. An automatic pilot steers the missile. Tiny telescopes automatically focused on "guide post" stars, or magnetic and radio signals from the ground, help keep the missile flying on the course. This system requires a very "intelligent" electronic brain.

USED AS AIR WEAPON



Air to Air

Air to Surface

Ground to Air

Air to Ship

Ship to Air

Ship to Shore

Ground to Ship

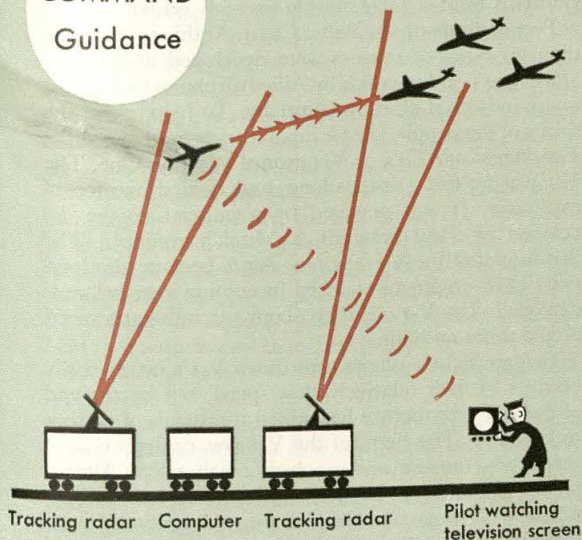
Ground to Ground

USED AS NAVAL WEAPON

USED AS GROUND FORCE WEAPON

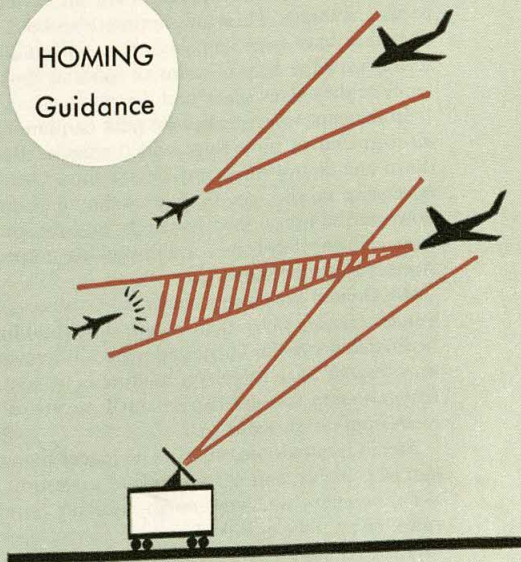
Guided missiles are being developed for all branches of the armed forces. Their long striking range and accuracy make them much more deadly than older weapons of war such as bombers, fighters, and artillery.

COMMAND Guidance



A human pilot on the ground sends commands to the missile to steer it in flight. Ground radar keeps track of both the missile and the target. A computer on the ground helps the pilot figure out what flying commands to send to the missile. The missile also may carry a television camera. It sends television pictures which the ground pilot watches and uses to fly, just as though he were actually in the missile.

HOMING Guidance



Adapted courtesy *Aero Digest*; Johns Hopkins University Applied Physics Laboratory

The missile uses an electronic eye to see the target, in order to find and destroy it. The missile's eye receives a signal from the target which attracts it. The eye may be a radar set which receives a radar echo from the target. The eye may catch signals from hot targets such as jet aircraft, ships, or heavy industrial plants. Other kinds of eyes may be photoelectric cells or magnetic detectors.

GUIDED MISSILE

contained, and require no information from outside the missile. The army's *Jupiter* and the air force's *Titan* have inertial systems.

Ballistic Missiles make up an important group of surface-to-surface missiles. A ballistic missile usually has a pre-set guidance system. This steers the missile only during the early part of its flight in order to point it in the right direction. The missile then coasts in a huge arc toward its target. Such missiles behave as if they had been shot from a long gun barrel.

Ballistic missiles come in many sizes, from the army's relatively small 75-mile *Corporal* to the air force's giant 9,000-mile *Atlas*. Missiles with ranges of 5,500 miles are called *Intercontinental Ballistic Missiles*, or ICBMs. Those with a range of about 1,500 miles, such as the *Jupiter* are called *Intermediate Range Ballistic Missiles*, or IRBMs.

Ballistic missiles have either liquid- or solid-fuel rocket engines and reach speeds of more than 10,000 miles an hour. Some soar to a height of 1,000 miles before diving toward the target. Some of these missiles have several *stages*, or propulsion systems. One stage may launch the missile. Then a second stage speeds it in the correct direction.

Nonballistic Missiles work more like airplanes. They often have wings and control devices similar to those on an airplane, and they depend on the atmosphere to help provide lift and steering forces. For example, the air force's *Bomarc* has a wingspread of 18 feet and twin ramjet engines.

Uses of Guided Missiles

As Air Weapons. A fighter plane can carry many small air-to-air guided missiles instead of machine guns, to destroy an enemy plane. Such fighter aircraft have radar and electronic brains that guide it at the enemy plane and then launch the missiles at the correct point to hit the target. These missiles are also built so that after they have been launched, they will guide themselves, with the help of radar or infrared devices, directly to the enemy plane and destroy it.

In the same way, an airplane pilot can launch larger air-to-ground or air-to-ship guided missiles that glide down and destroy an enemy city or ship. One kind of air-to-ship missile can drop from an airplane, glide down to the water, shed its wings, and dip under the water. There it becomes a ship-seeking torpedo that steers itself to the target.

As Ground Weapons. Long-range surface-to-surface guided missiles taller than a four-story building may be fired from one continent and wing all the way across an ocean to hit a target on another continent. Large surface-to-ship missiles can be used to guard coastal areas from enemy ships.

Smaller ground-to-air missiles no longer than a canoe can be launched and steered upward to destroy, in only a few minutes, attacking enemy aircraft hundreds of miles away. The missile has such range, speed, and ability to climb to high altitudes that it can be launched long before the aircraft come within range of anti-aircraft guns. The anti-aircraft missiles must be several times faster than the enemy planes in order to catch them.

As Naval Weapons. Navy ships can carry long-range ship-to-shore guided missiles to bombard enemy cities.

A submarine could come to the surface, fire such a missile, and duck down out of sight long before coastal defenders could spot it. Similar ship-to-ship missiles could be used in a battle between fleets hundreds of miles apart. Ship-to-air guided missiles, like ground-to-air missiles, can be used to defend ships from attacking enemy planes.

As Drones. Guided missiles with no explosives in them may be used as targets, or *drones*, for anti-aircraft practice. These drones are cheap enough to be shot down. They can perform all the maneuvers that a piloted airplane or an enemy guided missile might perform. They give the armed forces realistic practice for anti-aircraft defense.

Development of Guided Missiles

Early Experiments. The first guided missiles in the United States were built and tested from 1916 to 1918, during World War I. They were propeller-driven airplanes without pilots. These first guided missiles had *pre-set controls*, which means that their target could not be changed in flight. They had automatic pilots and vacuum devices to dive the planes at their destinations, and explode the bombs they carried. Charles F. Kettering, the automobile engineer, and Elmer Sperry, who developed the gyroscope, helped design these early types of guided missiles.

The first command-type guided missile, or one that could be maneuvered in flight by remote-control command, was a radio-controlled airplane. It was built by the United States Navy in 1924.

The first successful drone missile was demonstrated in Great Britain in 1935. It was called the *Queen Bee*. This drone was a standard Navy training plane fitted with radio controls. It was used as an anti-aircraft target. The next year the United States Navy revived its experiments with radio-controlled pilotless planes and began using them for anti-aircraft target practice.

In World War II. Germany made the first successful use of ground-to-ground guided missiles in combat. The Germans built a huge missile-research center in 1937 at Peenemünde on the Baltic Coast. At this center more than 20 types of missiles were developed and tested.

By 1944 bombing raids by Allied airplanes had ruined many industrial cities in Germany. To help revive the spirits of the people, the German leaders announced the *Vergeltungswaffe Eins*, or Vengeance Weapon One. The V-1 was 25 feet 4 inches long, and carried one ton of explosives. It was powered by a pulsejet engine developed by Paul Schmidt, a Munich engineer. The British called the V-1 the *buzz-bomb*, because the loud noise of its engine announced its coming long before it exploded. The V-1 could go about 150 miles at a speed of 360 miles an hour.

Defense fighter planes shot down V-1's rather easily because of their relatively slow speed, but by the end of the war buzz-bombs had killed thousands of persons in England. The flight of the V-1 was controlled by a magnetic compass and a clock mechanism. After a pre-set distance had been covered, the clock locked the missile's elevators and dived it into the ground.

On September 8, 1944, the Germans began to use an even more terrifying rocket-propelled V-2 guided missile. It was produced under the direction of Count Wernher von Braun, who came to the United States

after the war as a technical adviser for the United States Army. The V-2 looked like a giant wingless artillery shell. It was 46 feet long and had four arrowlike fins at its tail. It carried more than a ton of explosives. Like the V-1, it was a pre-set missile, but it was much more complicated, with more than 30,000 parts. The V-2 was guided by an automatic pilot and had an electronic brain, which shut off the rocket engine at the proper time to make the missile dive into its target. At its peak speed, the V-2 traveled at more than 3,600 miles an hour. This was much faster than the speed of sound, so people could not hear the V-2 coming. The V-2 could fly 200 miles. It was launched straight up like a skyrocket, and zoomed to a height of about 60 miles before diving toward its target.

In the United States many experiments were made with guided missiles. But only a few actually were put to use during World War II. The simplest guided missile was the Air Force's guided bomb called the *Azon*, a command-type air-to-ground missile. It was a standard 1,000-pound bomb which could be steered to the right and left by a radio operator in the bomber plane. Special control apparatus in the tail of the bomb consisted of gyroscopes, batteries, and a radio receiver. The *Azon* bomb was successfully used in 1944 against river locks and viaducts in Germany. Another successful but more complicated missile was the Navy's *Bat*. The *Bat* was a homing air-to-ship glide-bomb missile. While the *Bat* was still slung under the wing of an airplane, its radar nose was carefully pointed at an enemy ship. The radar was *locked-on* to the target and the *Bat* was released to glide and steer itself.

Postwar Research. Much of the missile work which was started during World War II was continued after the war. The United States Department of Defense divided the programs among the army, air force, and navy. The services, in turn, passed their problems on to government research laboratories, university laboratories, industrial laboratories, and aircraft companies.

Test-flying a missile is a difficult problem, because a human pilot cannot go along with it to report how it acts in the air. So the missile's first "flights" usually are made on a complicated electronic machine called an *analog computer*. All the information concerning the way the missile is to be built is set up on dials on the machine. Then the machine tells the scientists just how the missile will act when it is flown.

Recent Developments show a shift away from liquid-fuel missiles to solid-fuel ballistic missiles. Missiles propelled by solid fuels can be made smaller than liquid-fuel missiles. They also do not require the long *count-downs* needed to prepare liquid-fuel missiles for launching. The *Minuteman* is a solid-propellant missile that can be held in readiness and launched quickly.

In addition, scientists have worked to develop anti-missile missiles, such as the army's *Nike-Zeus*. Such missiles are intended to be exploded in the path of enemy ballistic missiles. Scientists have also developed *diversionary* missiles, such as the air force's *Green Quail* and *Bull Goose*. These missiles distract an enemy so that the main missile attack may hit its targets.

In 1959, a missile was used for the first time to transport mail. A *Regulus I* missile launched from a surfaced submarine 100 miles at sea carried 3,000 letters to a Florida naval air station. The first *Polaris* missile was

launched from a submerged nuclear-powered submarine in 1960.

WALTER A. GOOD

Related Articles in WORLD BOOK include:

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Holloman Air Force Base	Rocket
Jet Propulsion	Space Travel
Navy (Atomic-Powered Navies)	Warren Air Force Base
	Warship (pictures)
	White Sands Missile Range

Outline

I. Kinds of Guided Missiles

- | | |
|-----------------------|--------------------------|
| A. By Use | C. Ballistic Missiles |
| B. By Guidance System | D. Nonballistic Missiles |

II. Uses of Guided Missiles

- | | |
|----------------------|---------------------|
| A. As Air Weapons | C. As Naval Weapons |
| B. As Ground Weapons | D. As Drones |

III. Development of Guided Missiles

Questions

- Why do rocket experts call guided missiles *birds*?
- What are three reasons why missiles may replace military airplanes?
- What kind of missile is taller than a four-story building?
- What is a *homing* guidance system? An *inertial* system?
- After it is fired, what kind of missile coasts toward its target?
- What are surface-to-surface missiles called in the navy?
- What country first successfully used guided missiles in combat?
- What kind of missile is the *Rat*?
- To what peaceful use was a *Regulus I* missile put in 1959?
- What is a *drone* missile?
- What is meant by ICBM? By IRBM?

GUIDO D'AREZZO, *GWEE doh dah REHT soh* (995?-1050?), a Benedictine monk, was an Italian music teacher. He introduced the four-line staff, and is credited with naming the first six notes of the scale *ut, re, mi, fa, sol, and la*. (Later, *do* was substituted for *ut*.) These reforms made the teaching of music much easier. Pope John XIX liked Guido's musical ideas, and helped make them popular.

IRVING KOLODIN

GUIDON. See FLAG (Kinds of Flags).

GUILD, *gild*, in the Middle Ages was an important type of association. The best-known guilds were the societies of merchants and workmen, but religious, military, and social guilds also had many members.

Merchants' Guilds were more important in England than anywhere else. They flourished between 1100 and 1500. Craftsmen, or artisans, who made and sold their own products, as well as merchants who bought and sold the products of others, belonged to the merchants' guilds. The members of a single guild usually lived in the same town, and often had complete control of local retail trade. Anyone could join who paid his taxes.

Craft Guilds were made up of all workmen in a town who shared in a particular craft or trade, such as weaving or working with gold. The members were divided into three classes. At the top were the *masters*, who alone had the right to buy raw materials and to sell finished products. The second class was composed of *journeymen*, who received wages from their masters and sometimes lived with them. The beginners at the craft were called

GUILDER

apprentices. They received board, lodging, and training in exchange for their work.

The apprentice often worked for years before becoming a journeyman. The journeyman also had a long education and was required to construct a *masterpiece* which met rigid standards before he was declared a master.

In addition, he needed money so that he could set up an establishment. Comparatively few of them became masters.

In the late Middle Ages, wealth was often the chief requirement for becoming a master. During the 1300's and 1400's, many journeymen realized that they would have little chance to become masters, and formed journeymen's guilds of their own.

These journeymen's guilds became the forerunners of present labor organizations. The original craft guilds resembled in many ways modern associations of competing businessmen. A few craft guilds lasted until the late 1700's.

WILLIAM F. McDONALD

See also APPRENTICE; DRAMA (The Medieval Theater); LABOR (pictures, Labor in the Middle Ages).

GUILDER is the gold monetary unit of The Netherlands. It is also coined in silver. The guilder is also used in Curaçao.

The name applies also to several German and Dutch coins that are no longer in use. Other names for the guilder are *gulden* and *florin*. See also FLORIN; MONEY (table, Values).

GUILFORD COLLEGE is a coeducational liberal arts school at Greensboro, N.C. It was founded in 1834 by the Society of Friends as the New Garden Boarding School, and was chartered in 1837. Courses in liberal arts lead to A.B. and B.S. degrees. For enrollment, see UNIVERSITIES AND COLLEGES (table).

GUILFORD COURTHOUSE, BATTLE OF. See REVOLUTIONARY WAR IN AMERICA (The War in the South; table, Major Battles).

GUILFORD COURTHOUSE NATIONAL MILITARY PARK. See NATIONAL PARK (National Military Parks).

GUILLEMOT, GILL ee

moh, is a sea bird that belongs to the auk family. The *black guillemot*, or *sea pigeon*, lives on both coasts of the North Atlantic. It grows about 13 inches long, and has a slender, pointed bill. Its feathers are sooty in the summer and white and black during the winter. *Mand's guillemot* lives in the Arctic regions of America and the *pigeon guillemot*, also called *sea pigeon*, lives on the Pacific Coast of America.



The Guillemot

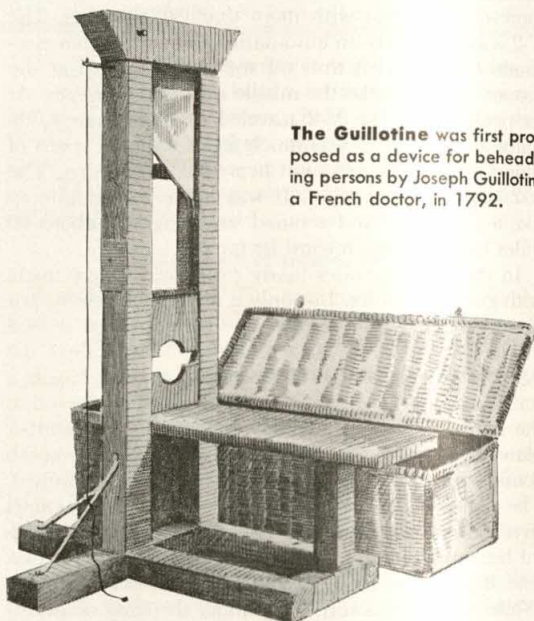
Scientific Classification. The guillemot belongs to the family *Alcidae*. The black guillemot is genus *Cephus*, species *grylle*.

ALEXANDER WETMORE

See also AUK.

GUILLOTINE, GILL oh teen, is a beheading machine. It became the official instrument of execution in France in 1792, during the French Revolution. The device was

named for Joseph Ignace Guillotin (1738-1814), a member of the Revolutionary assembly. He suggested that persons condemned to death could be executed quickly and mercifully by such a machine.



The Guillotine was first proposed as a device for beheading persons by Joseph Guillotin, a French doctor, in 1792.

A guillotine has two posts joined by a crossbeam at the top. A heavy steel knife with a slanting edge fits in grooves in the posts. A cord holds the knife in place. When the executioner cuts the cord, the knife drops and cuts off the head of the victim.

A machine similar to the guillotine is said to have been used in ancient Persia. The Italians had a beheading machine called the *mannaia*, and the Scots used a device called the *maiden*.

MARVIN E. WOLFGANG

GUINEA, GIN ih, is the name of a region on the western coast of Africa, along the Gulf of Guinea and the Atlantic Ocean. Its exact boundaries have never been clearly defined. But it is commonly thought of as the area between Gambia and Gabon. Authorities first used the name *Guinea* for the region in the 1400's. They divided the Guinea Coast into the Grain Coast, which includes modern Liberia; the Ivory Coast; the Gold Coast, which now lies within Ghana; and the Slave Coast, which includes modern Dahomey and Nigeria. Some experts believe the name came from a Berber word meaning the *land of the Blacks*. Three countries in this region now use the name *Guinea*. They are Portuguese Guinea, the Republic of Guinea, and Spanish Guinea.

Portuguese Guinea lies between Senegal and the Republic of Guinea. It covers 13,948 square miles, and has a population of 510,777. It also includes the Bijagos, or Bissagos, Islands off the coast. Bissau, the capital, is the largest city of this Portuguese overseas province.



Republic of Guinea is bounded by Portuguese Guinea and Sierra Leone. The Republic of Guinea was an overseas department of France until it became a republic when it voted for independence in a French referendum in 1958. Guinea joined the United Nations in December, 1958. Guinea has an area of 106,200 square miles, and a population of 2,709,000. Its capital is Conakry, an island linked to the mainland by a bridge.

Spanish Guinea includes the mainland territory of Río Muni and the islands of Annobón, Corisco, and Fernando Póo. This colony of Spain has an area of 10,800 square miles and a population of 196,049. Santa Isabel on Fernando Póo is the capital. KENNETH ROBINSON

See also AFRICA (color map); CONAKRY; PORTUGUESE GUINEA; SPANISH GUINEA.



Chase Manhattan Bank Money Museum

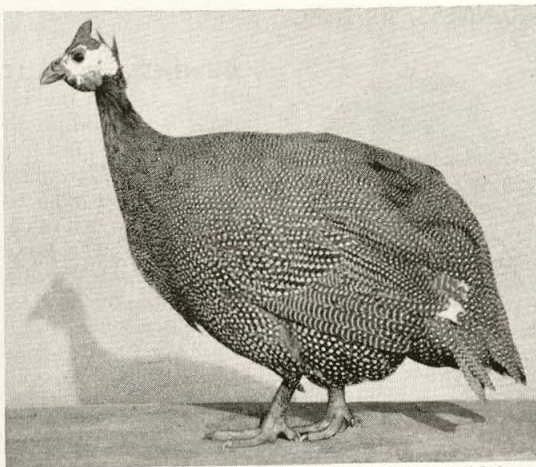
The Guinea Is No Longer in Circulation.

GUINEA was an old English coin, equal to 21 shillings. It was first coined out of gold from Guinea and received its name from this region. This took place in 1663, during the reign of Charles II. The guinea served as the chief English coin until 1813, when the *sovereign* took its place. No guineas are in circulation today. See also POUND STERLING.

GUINEA, GULF OF. See GULF OF GUINEA.

GUINEA FOWL is a close relative of the pheasant. Guinea fowls have dark gray feathers with small white spots. The neck and head are bare, and a bony ridge, or *casque*, covers the top of the head. They can be bred like poultry, but are quarrelsome and hard to raise. Their continual harsh cries make them unpopular, although they are good "watchdogs." People consider the flesh a delicacy and also eat the small, spotted guinea eggs.

Scientific Classification. The guinea fowl belongs to the



U. S. Bureau of Animal Industry

The Guinea Fowl originated in Africa, and is a close relative of the pheasant. Farmers value them as "watchdogs."

family *Numididae*. It is classified as genus *Numida*, species *meleagris*. JOSEPH J. HICKEY

See also PHEASANT; POULTRY.

GUINEA PIG is a small, hairy animal that is widely used for experiments in medicine and biology. It is also a favorite pet. Guinea pigs are about 6 inches long, and have several types of coloring, and no tail. The different varieties of guinea pigs are known by such colors as tortoise shell, red, brown, and white.

Bacteriologists often make experiments on guinea pigs in their laboratories. The animals make good subjects because they are strong and have naturally clean habits. They will rest quietly in the hand while being injected with serum. The injection seems to give them hardly any pain or discomfort.

Guinea pigs are also used in vivisection. In this kind of experiment, the scientist operates on a living animal. He uses antiseptics, and gives the animals anesthetics in all severe operations. No animal suffers needlessly.

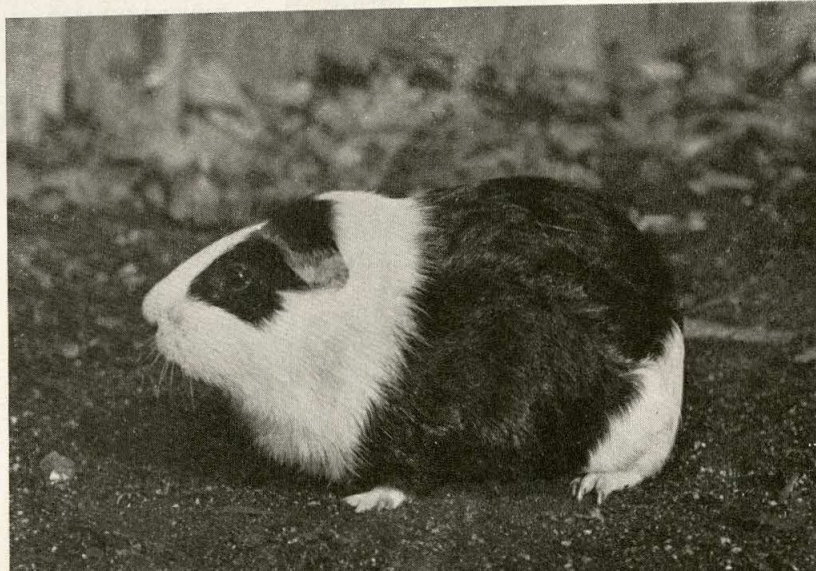
Scientific Classification. The guinea pig belongs to the cavy family *Caviidae*. It is classified as genus *Cavia*, species *aperea*. STANLEY P. YOUNG

See also CAVY; VIVISECTION.

GUINEVERE. See ARTHUR, KING; LANCELOT, SIR.

New York Zoological Society

The Guinea Pig, whose correct name is cavy, makes a sound like a shrill whistle. It is used in biological experiments.



GUINNESS, SIR ALEC



© 1957 Columbia Pictures Corp.

Sir Alec Guinness

GUINNESS, SIR ALEC

(1914-), is an internationally famous British actor. He scored his first film success in *Great Expectations* in 1947. Another of his famous parts was that of the British colonel in *The Bridge on the River Kwai*. For this role he won the motion-picture "Best Actor" award in 1958 from the Academy of Motion Picture Arts and Sciences. Guinness was born in London. He made his stage debut in the early

1930's. He won praise as the psychologist in T. S. Eliot's *The Cocktail Party*. His other motion pictures include *Kind Hearts and Coronets* and *The Lavender Hill Mob*.

HARRIET VAN HORNE

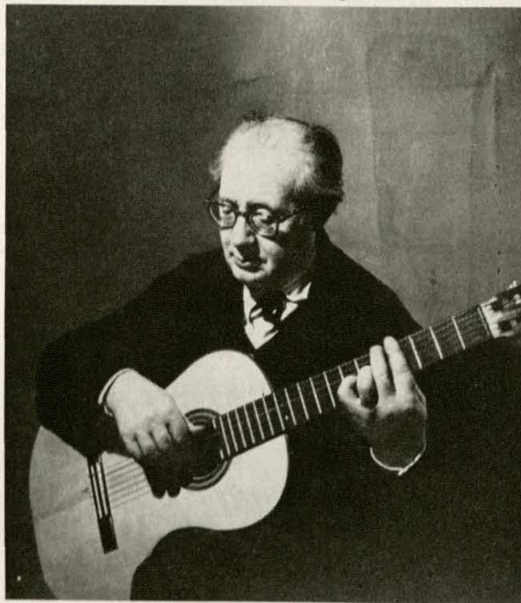
GUISCARD, ROBERT. See NORMAN.

GUISE. See HUGUENOTS.

GUITAR, *gih TAHHR*, is one of the largest plucked string instruments in common use. It is used chiefly to accompany solo singing, but is also used in dance bands and other ensembles. It is made of light wood with flat top and back, and has six strings. These are tuned in

Guitarist Andres Segovia used the guitar to play classical music. It also is often used as accompaniment for folk songs.

© Dr. I. W. Schmidt, FPSA



fourths except for one irregular third in the upper register. The fingerboard has *frets*, or narrow metal cross strips against which the strings are *stopped*, or pressed, with the fingers of the left hand. The player sounds the bass notes with his right thumb, and treble notes with his first three fingers.

Historians believe the guitar was first developed in the Middle East. A piece of Hittite sculpture, made

around 1000 B.C., shows an instrument with some features of the modern guitar. The Moors may have brought the guitar with them to Spain during the Middle Ages. The invention of the Spanish guitar in the 1500's is credited to Vicente Espinel. CHARLES B. RIGHTER

See also SPAIN (picture).

GUITAR, STEEL. See HAWAII (Music).

GUITEAU, CHARLES J. See GARFIELD, JAMES ABRAM (Assassination).

GUITRY, *gee TREE*, **SACHA** (1885-1957), was a popular French actor, playwright, and director. During his lifetime, he wrote 115 plays and 29 motion-picture scripts. In most of these, he also acted the leading part. His best-known plays were *Deburau* (1918) and *Pasteur* (1919). In 1939, he was elected to membership in *l'Académie Goncourt*. Guitry was born in St. Petersburg (now Leningrad), Russia.

RICHARD MOODY

GUJRANWALA, *gooj run WAH luh* (pop. 120,860; alt. 745 ft.), lies in West Pakistan, about 40 miles northwest of Lahore. For location, see PAKISTAN (color map). The city has many handicraft industries and serves as a trading center for such agricultural products as rice, wheat, millet, cotton, and sugar cane. Gujranwala was the birthplace of the famous Sikh ruler, Ranjit Singh (1780-1839).

ROBERT I. CRANE

GULDEN. See GUILDER.

GULES. See HERALDRY (Parts of the Shield).

GULF is an extensive indentation of a shore line bordering a lake, bay, or ocean. People often use the term *gulf* interchangeably with the term *bay*. The terms *bight* and *sound* are sometimes used to describe a gulf. Bights usually penetrate less deeply into land areas than gulfs, as exemplified by the Great Australian Bight. King Sound of northwestern Australia also fits the definition of a gulf or bay. The wide difference in the use of names for shore-line indentations can easily be seen on Australia's northwestern coast. Three indentations of equal size and similar shape have different names: King Sound, Collier Bay, and Admiralty Gulf. Gulfs vary in size from small, like Greece's Gulf of Corinth, to enormous, like the Gulf of Mexico. Gulfs frequently are formed when a portion of the earth's crust is depressed below sea level, as, for example, the Gulf of St. Lawrence. Less commonly, gulfs result when a fractured part of the earth's surface slips below sea level, as when the Gulf of California was formed in Mexico. See also BAY; SOUND (body of water).

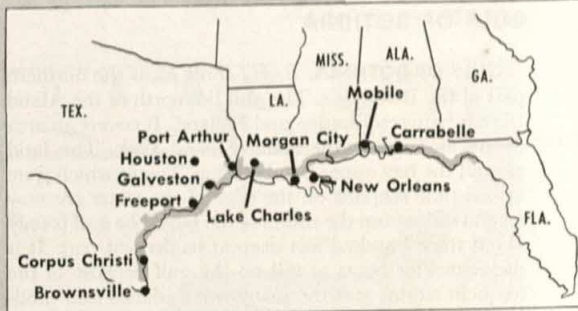
J. ROWLAND ILLICK

GULF COASTAL PLAIN extends from Florida to Mexico, along the Gulf of Mexico. The land is low and generally flat along the coast, and gently rolling inland. Sugar cane, rice, and citrus fruits are grown there.

GULF FREEWAY. See ROADS AND HIGHWAYS (Some Important Roads and Highways).

GULF INTRACOASTAL WATERWAY is a water route along the Gulf of Mexico from Carrabelle, Fla., to Brownsville, Tex. Workmen completed this \$80,000,000 inland waterway in 1949. It is from 9 to 12 feet deep and 125 feet wide. Freight barges and pleasure boats travel 1,116 miles along the Gulf Coast, safe from the dangers of the open sea. Barges from the East and Middle West move down the Mississippi River to enter the Gulf Intracoastal Waterway. A canal will connect it with the Atlantic Intracoastal Waterway. E. WILLARD MILLER

See also ATLANTIC INTRACOASTAL WATERWAY; INLAND WATERWAY.



Corps of Engineers, U.S. Army

The Gulf Intracoastal Waterway provides a protected water route along the Gulf of Mexico from Carrabelle, Fla., to Brownsville, Tex. Barges pulled by tugboats on the waterway, left, make their way through the flat coastal marshes of Louisiana.



American Commercial Barge Line Co.

Special Barge-Loading equipment quickly fills the bins on a barge docked at a Louisiana salt mine.



Corps of Engineers, U.S. Army

A Tugboat with Two Petroleum Barges in Tow clears Vermilion Lock in south-central Louisiana. This lock keeps salt water from the Gulf from flowing into the intracoastal waterway.

GULF OF BOTHNIA

GULF OF BOTHNIA, *BAHTH nih ah*, is the northern part of the Baltic Sea. The gulf lies north of the Åland Islands between Sweden and Finland. It covers an area nearly as large as the state of New York. The land around the bay appears to be rising. Towns which were at one time seaports on the edge of the water are now several miles from the shores of the bay. The gulf is only about three hundred feet deep at its deepest part. It is dangerous for boats to sail on the gulf because of the frequent storms and the many small islands and sandbanks. Large quantities of lumber are shipped from Swedish and Finnish ports on the bay. In winter, when the gulf is frozen over, freight is carried across the ice on sleighs.

ROBERT O. REID

GULF OF CALIFORNIA is an arm of the Pacific Ocean that lies between the Lower California peninsula and the mainland of Mexico. The gulf was once known as the Sea of Cortes, because Hernando Cortes first explored it in 1536. It was also called the Vermilion Sea. Many kinds of fish, including big-game sailfish, can be found there.

Oyster beds lie along the eastern shore. The western shore has pearl and sponge fisheries. The gulf is about 700 miles long, from 30 to 150 miles wide, and from 600 to 6,000 feet deep. The Colorado River is the largest of many streams that flow into the gulf. The largest islands in the gulf are Angel de la Guarda and Tiburón. F. G. WALTON SMITH



The Gulf of California

GULF OF FINLAND is an eastern arm of the Baltic Sea that separates southern Finland from Estonia, now part of Russia. The gulf is about 350 miles long and from 10 to 80 miles wide. Lake Ladoga in Russia

The Gulf of Finland Separates Finland and Russia.



empties into it. Rocky islands lie in the gulf, especially near the northern shore.

Ships use the gulf even in winter, when icebreakers usually keep the sea lanes open to the western ports. Important ports on the gulf include Helsinki and Kotka on the Finnish shore, and Leningrad, Vyborg, and Tallinn on the Russian side of the waterway. See RUSSIA (color map).

JOHN H. WUORINEN

GULF OF FONSECA, *fawn SAY kah*, is an arm of the Pacific Ocean in Central America. This gulf washes the shores of Nicaragua, El Salvador, and Honduras. The United States Navy maintains a base on the Nicaraguan coast of the Gulf of Fonseca. The navy acquired the base through a treaty that was drawn up in 1916 and ratified in 1926.

GULF OF GENOA is a northern arm of the Mediterranean Sea on which the Italian port of Genoa stands. The part of the Mediterranean lying next to the gulf is called the Ligurian Sea. During World War II, the Italian Navy used the Gulf of Genoa as an anchorage for warships.

GULF OF GUINEA is an arm of the Atlantic Ocean that cuts into the west coast of Africa. It marks the point where the African continent narrows. The Ivory Coast, Ghana, Togo, Dahomey, Nigeria, the British Cameroons, and Cameroun border the Gulf of Guinea.

GULF OF MEXICO is a great curved arm of the Atlantic Ocean. It is almost surrounded by the United States and Mexico. The gulf forms a huge ocean basin that covers nearly 700,000 square miles. It is 800 miles long (north to south) and 1,100 miles wide. A line drawn between the tips of the Florida and Yucatán peninsulas would mark the eastern edge of the gulf. The island of Cuba lies halfway between these two peninsulas. The Yucatán Channel connects the gulf with the Caribbean Sea and the Straits of Florida join it to the Atlantic Ocean.

The low, level coast line of the Gulf of Mexico is about 3,000 miles long. It contains hundreds of lagoons and many salty marshes bordered by sand bars. It has few good harbors. The best are the gulf ports of Veracruz, Mexico; Galveston, Tex.; Mobile, Ala.; Pensacola and Tampa, Fla.; and Havana, Cuba.

The water of the gulf is deepest (12,700 feet) near the coast of Mexico. The greatest depth of the gulf in other places is about 10,000 feet. The Yucatán Channel and

The Gulf of Mexico Is an Arm of the Atlantic Ocean.



the Straits of Florida are not nearly so deep. The gulf has many shallow places with gently sloping beds, formed by the silt poured in by rivers. The Mississippi is the largest river that empties into the gulf. Others are the Rio Grande, the Colorado, the Mobile, and the Apalachicola. Many keys, or small islands, lie off the coasts of Florida and Yucatán.

The Gulf Stream, which enters the Gulf of Mexico through the Yucatán Channel, raises the temperature of the gulf water about 9 degrees. It leaves the gulf through the Straits of Florida.

F. G. WALTON SMITH

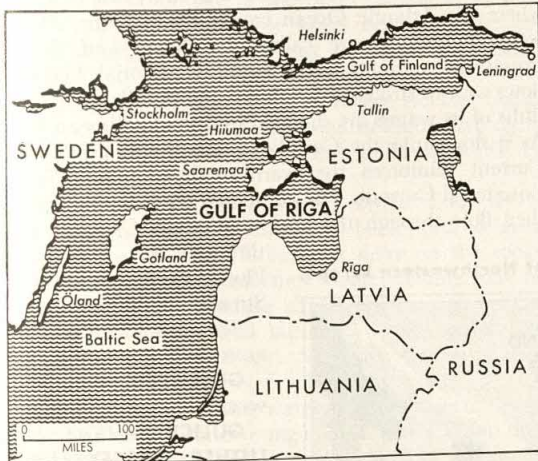
See also GULF STREAM; MISSISSIPPI RIVER.

GULF OF OMAN is an arm of the Arabian Sea. It lies between Oman, in Arabia, and Iran. The gulf measures about 350 miles in length, and is 200 miles wide at its broadest point. The Strait of Hormuz joins the gulf to the Persian Gulf in the north. Ports on the Gulf of Oman include Muscat, Matrah, and Jask.

GULF OF RĪGA, *REE guh*, is an inlet on the east side of the Baltic Sea. It is about 100 miles long from north to south, and 70 miles wide. The gulf forms part of the shore line of Latvia and Estonia. For location, see ESTONIA (map). It never entirely freezes over in winter, even though the water is shallow. The harbor of Rīga, Latvia, receives food, manufactured goods, coal, and cotton from foreign countries. The city of Rīga is on the Dvina River, the largest stream that empties into



Canadian Provinces Surround the Gulf of Saint Lawrence.



The Gulf of Rīga Is a Large Inlet of the Baltic Sea.

the Gulf of Rīga. Ships can sail along the coast of the Gulf of Riga for nine months of the year. Ice blocks shipping during most of the winter.

ROBERT O. REID

GULF OF SAINT LAWRENCE is a deep arm of the Atlantic Ocean, and the largest gulf on the North American coast, except for the Gulf of Mexico. The Gulf of Saint Lawrence is partly bordered by Newfoundland on the east, and by Nova Scotia and New Brunswick on the south. It washes the eastern shores of Quebec. The gulf is the outlet of the Saint Lawrence River and the Great Lakes, which are the chief highways of trade for eastern Canada and the northern United States. Since the opening of the deepened Saint Lawrence Seaway in 1959, large ocean-going vessels have been able to sail from the Gulf of Saint Lawrence to the farthest ends of the Great Lakes. The Saint Lawrence Seaway makes the gulf the gateway to the transatlantic

trade of the North American interior. The gulf enters the Atlantic by two channels. Cabot Strait, the larger of the channels, extends for over 60 miles between Cape Breton and Newfoundland. The Strait of Belle Isle lies between Labrador and Newfoundland. For location, see CANADA (color map).

Telegraph cables cross the Gulf of Saint Lawrence, and many steamers sail between Quebec and the Atlantic Provinces. The tides are low, but the changing currents, dense fogs, and floating ice often make shipping dangerous. Prince Edward Island is in the south end of the gulf. Anticosti Island is near the mouth of the Saint Lawrence River. There are several clusters of smaller islands, especially in the southern part of the gulf. Many tiny islands lie along the rocky northern shores.

Both the Gulf of Saint Lawrence and the Saint Lawrence River were discovered by Jacques Cartier. On his second trip, on August 10, 1535, Cartier entered a bay on the north coast of the gulf. It was the feast day of Saint Lawrence, and he called the gulf the *Baye Saint Laurens*. This name was gradually applied to the gulf and river.

M. G. BALLANTYNE

See also SAINT LAWRENCE RIVER; SAINT LAWRENCE SEAWAY.

GULF OF TARANTO is the arm of the Ionian Sea at the tip of Italy that forms the "instep" of the Italian boot. For location, see ITALY (color map). It lies between Cape Santa Maria di Leuca and Cape Colonne. The Gulf of Taranto is 85 miles long and 85 miles wide.

GULF OIL CORPORATION. See PETROLEUM (Leading Oil Companies).

GULF STATES are the states that border on the Gulf of Mexico. They are Florida, Alabama, Mississippi, Louisiana, and Texas.

GULF STREAM

GULF STREAM is the second largest ocean current. Only the Antarctic Circumpolar Current is greater. The Gulf Stream has its source in the warm waters of the eastern part of the Gulf of Mexico. These waters pass through the Straits of Florida to become the Gulf Stream. The stream flows northeastward across the Atlantic toward the coast of Europe. The Gulf Stream flows as fast as 70 miles a day. Its rate of flow, measured in cubic feet per second, is about 1,000 times greater than that of the Mississippi River.

Importance. The Gulf Stream is at least partly responsible for the warm southwesterly winds that make the climate of Great Britain and northwestern Europe much warmer than parts of North America that lie equally far north. These winds pick up heat and moisture from the Sargasso Sea and the Gulf Stream.

These warm winds greatly influence the climate of the countries they touch. For example, the average January temperature in northern Norway is about 45°F., higher than normal for that latitude. The warm waters of the Gulf Stream keep many ports in northwestern Europe ice-free all winter. Hammerfest, Norway, is an important sea-fishing center in winter, while Rīga, Latvia, 800 miles south of Hammerfest, is ice-bound.

The Gulf Stream is also an aid to shipping. Many large oil tankers and ore carriers, traveling from South America to Atlantic coastal harbors, attempt to "ride" the Gulf Stream on their northbound journey. This enables them to save valuable shipping time.

Route. After the Gulf Stream flows through the Straits of Florida, it passes the Little Bahama Bank. The Antilles Current, which flows northwest along the Atlantic side of the West Indies, then joins it. The combined current continues northward, widening and slow-

ing as it goes. The Gulf Stream forms the northwest boundary of the Sargasso Sea, separating the warm waters of that sea from the chill waters of the North Atlantic (see **SARGASSO SEA**). The stream, about 50 miles wide and 3,000 feet deep, follows the Atlantic coast of North America. A narrow strip of cold water, called the "cold wall" by sailors, separates the Gulf Stream from the coast. By the time the Gulf Stream reaches Charleston, S.C., it has slowed to about 40 miles a day. At the Newfoundland Banks, it travels about 10 miles a day. At the southern edge of the Newfoundland Banks, the Gulf Stream ceases to be a strong current. It spreads out, and becomes a general drift of warm water that moves eastward toward Europe. This part of the stream is the North Atlantic Current.

As the North Atlantic Current approaches Europe, it divides into two parts. One stream flows southward toward the west coast of Africa. The other moves northward toward the British Isles.

The northern current divides into three smaller streams. One branch runs between the Faeroe and Shetland islands north of Scotland, and then goes northward into the Arctic Ocean. A second branch flows along the west coast of Iceland. The third and smallest branch goes up Davis Strait, along the coast of Greenland, and into Baffin Bay.

Cause. Winds and currents are the main cause of the Gulf Stream. Trade winds cause a westerly flow of water where the Atlantic Ocean crosses the equator. These westerly currents are called the North and South Equatorial currents. The South Equatorial Current flows west to strike the north coast of Brazil, where two fifths of its waters are directed into the Caribbean Sea. As it flows into the Caribbean, the South Equatorial Current reinforces the warm waters of the North Equatorial Current. The combined equatorial currents then flow through the narrow Yucatán Channel and

through the Straits of Florida to become the Gulf Stream. WAYNE V. BURT

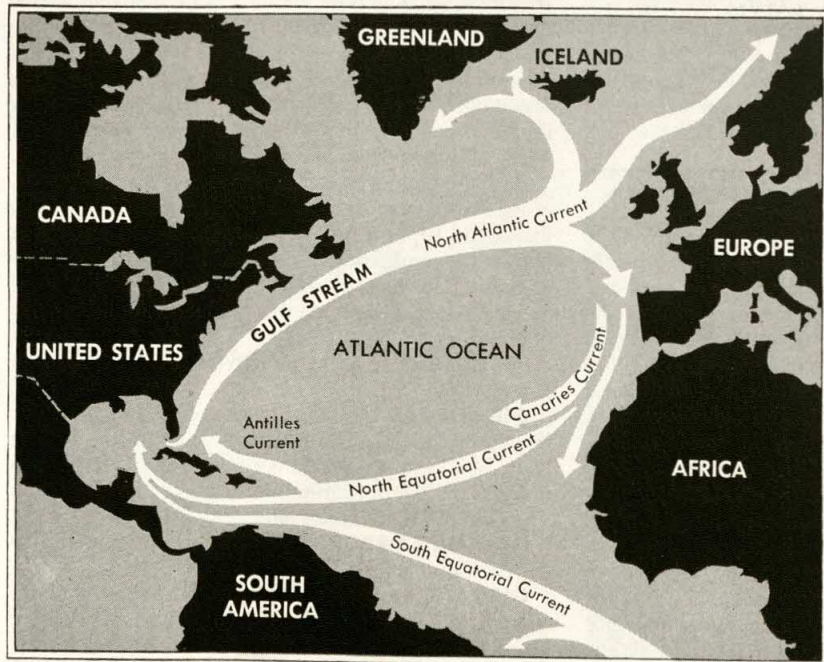
See also **OCEAN CURRENTS**.

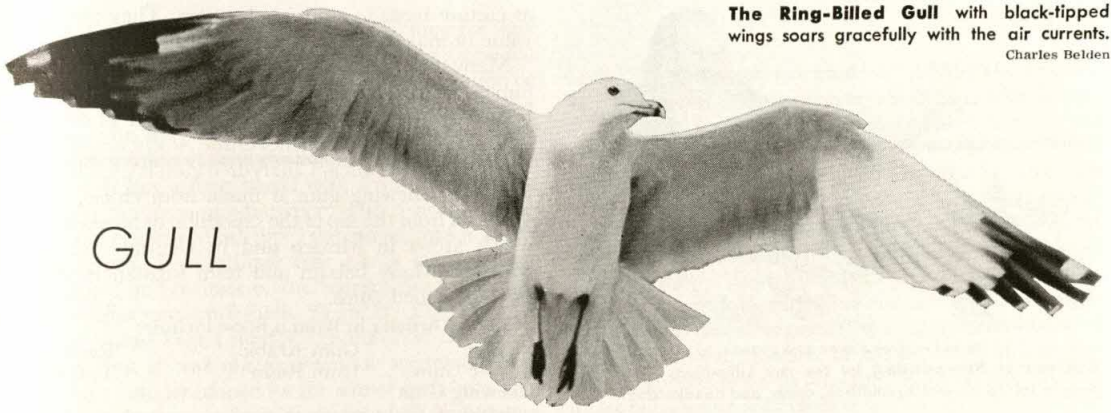
GULFWEED. See **SEA-WEED**.

GULICK, GYOO lick, LUTHER HALSEY (1865-1918), an American physical education teacher, encouraged James Naismith to originate the game of basketball. Gulick helped his wife, Charlotte Vetter Gulick, organize the Camp Fire Girls in 1910. He also established physical training at the Young Men's Christian Association College, originated the YMCA emblem, and reorganized physical education in the New York schools. He was born in Honolulu, Hawaii. See also **CAMP FIRE GIRLS** (History); **NAISMITH, J. A.**

RICHARD G. HACKENBERG

The Gulf Stream Has an Important Effect on the Climate of Northwestern Europe.





GULL

GULL is a long-winged bird about the size of a pigeon. Gulls are often seen swooping over most large bodies of water. Most gulls make their home near the ocean, but they also live on the Great Lakes and other inland waters. Gulls are close relatives of another kind of sea bird, the tern.

Adult gulls are generally pearl gray above and white below. The feathers of some species also show some black, brown, or gray. The colors change with the season and with the age of the birds. Young birds look grayish or brownish. Some kinds become white the second year, while others may not grow their adult feathers until they are four years old. Most gulls have broader wings, squarer tails, and larger, stockier bodies than terns. Gulls look less graceful in flight than terns, but they can swim better. Ocean gulls often rest by floating on the water.

American gulls are migratory birds. They fly to warm regions in the winter, and fly back north to breed in the summer. They build their nests on the rocky ledges of islands or in marshes. Large colonies may be seen where their breeding places have not been disturbed. The female gull lays one to four grayish or greenish-brown spotted eggs. Soft fluffy feathers, called *down*, cover the young birds when they hatch.

Gulls eat fish and other water animals, insects, rotten meat, and the eggs and young of other birds. When they live around harbors and shore waters, they are useful scavengers. They devour any kind of food or garbage that floats. Gulls are familiar to steamship passengers, because great flocks follow ships for hours at a time. If food is thrown overboard, the birds swoop down eagerly to the water, and pick it from the surface with their strong hooked bills. Inland gulls destroy many insects. Salt Lake City residents erected a monument to the gulls that destroyed millions of crickets in 1848 and saved the crops of the settlers.

Their Homes. In North America, the *ring-billed* gull lives on the coasts and in the Mississippi Valley. The *kittiwake* makes its home in arctic America. The *great black-backed* gull is another bird of the Atlantic Coast. *Franklin's* gull of the upper Mississippi Valley is a bird of the plains and marshy lakes. The *black-headed* or *laughing* gull lives from the Atlantic and Gulf coasts to the West Indies. The *California* gull lives on the Pacific Coast. The *herring* gull is the large white bird often seen

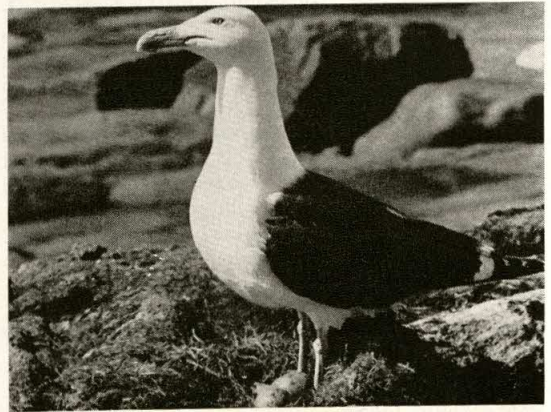
at Atlantic and Pacific ports. The herring gull is also seen on inland waters.

Scientific Classification. Gulls belong to the family *Laridae*. The ring-billed gull is genus *Larus*, species *delawarensis*. The herring gull is *L. argentatus*. The great black-backed gull is *L. marinus*.

ALEXANDER WETMORE

See also BIRD (table, State Birds; color pictures, Water Birds [California Gull; Laughing Gull]); FRANKLIN'S GULL; JAEGER; KITTIWAKE; TERN.

GULLET. See ESOPHAGUS.



The Great Black-Backed Gull, above, nests along the northern Atlantic coast. The black-headed gull, below, breeds along the coasts of the Gulf of Mexico, but winters in South America.

Chicago Academy of Science





From *Tenggren's Story Book* © 1944 by Simon & Schuster

Gulliver Is Surrounded by the tiny Lilliputians. The 6-inch people seized his watch, snuffbox, comb, and handkerchief.

GULLIVER'S TRAVELS is a great satire in English literature, and a favorite children's story. It was published in London in 1726 under the name of Lemuel Gulliver, supposedly a ship's surgeon and later a captain. In reality, Jonathan Swift, the witty dean of St. Patrick's Cathedral in Dublin, wrote the book.

Swift wanted to make fun of men in high office. But the tale was so fascinating that even the people Swift attacked failed to realize its meaning at first. Nearly 80 years later, a Glasgow printer published a simplified children's version of the first two parts. This version became a juvenile classic. Many adults enjoy reading the original story in its entirety.

In the book, Dr. Gulliver describes his fantastic adventures in distant lands. The story begins with a shipwreck. Gulliver, the only survivor, swims ashore. He finds himself in Lilliput, where the people are only 6 inches high. But the Lilliputians take themselves very seriously. In writing the emperor's description of his country, Swift makes fun of his own land, and of all people who take themselves too seriously. After a series of remarkable adventures, Gulliver leaves Lilliput.

Gulliver's second voyage takes him to Brobdingnag. The people there are tremendous giants. Gulliver becomes the pet of a little girl nine years old, "and not above 40 foot high, being little for her age." He has terrifying experiences in this country. The last two parts of the book tell of Gulliver's voyages to the flying island of Laputa and the country of the Houyhnhnms, the wise, talking horses.

GEORGE A. WICKES

See also **SATIRE**; **SWIFT**, **JONATHAN**.

GULLSTRAND, ALLVAR (1862-1930), a Swedish ophthalmologist, won the Nobel prize for medicine and physiology in 1911 for his work on the refraction of light through the eye. By investigating the structure of the eye lens, he concluded that *accommodation*, the ability of the eye to see at different distances, resulted chiefly from changes in the surface curvature of the lens and also from rearrangement of internal fibers of the eye. Gullstrand also improved the ophthalmoscope. He was born at Landskrona.

HENRY H. FERTIG

GULLY. See **VALLEY**.

GUM is the name of a variety of sticky, clinging substances. Such substances are called *adhesives*. Gum is made from the sap which flows from certain fruit trees, especially plum, peach, and cherry. Real gum can be dissolved in water, but not in alcohol. It has no smell. Gums are used for mucilage, in mixing medicines, and

as culture bases in studying bacteria. They are also of value in making stationery, ink, and matches.

Many pleasant-smelling substances used to make perfumes and incense are called gums. Gum arabic is the best known of these. Gum arabic is made of dried sap from the stems and branches of the *Acacia senegal*, a tree which grows in Africa. Cherry-tree gum is used to stiffen felt hats. Chewing gum is made from chicle, a gum obtained from the sap of the sapodilla, or naseberry tree, which grows in Mexico and in Central and South America. Many balsam and resin substances are improperly called gums.

C. L. MANTELL

Related Articles in WORLD BOOK include:

Balsam	Gum Arabic	Resin
Bubble Gum	Gum Resin	Tragacanth
Chewing Gum		

GUM, BUBBLE. See **BUBBLE GUM**.

GUM, CHEWING. See **CHEWING GUM**.

GUM ARABIC is a brittle kind of gum used chiefly in making perfumes, medicine, candies, and mucilage. Gum arabic is sometimes called *gum acacia*. It is obtained from the sap of the *Acacia senegal*, a tree which grows in the Sudan in Africa. Gum arabic dissolves easily in water. When used for mucilage on labels and envelope flaps, the gum is mixed with glycerin and sugar. This prevents its becoming stiff enough to crack and fall from the paper. Gum arabic is also used to add luster and stiffening to textiles.

C. L. MANTELL

See also **GUM**; **MUCILAGE**; **TRAGACANTH**.

GUM RESIN is a group of vegetable substances which are obtained from the leaves, bark, and roots of plants. They usually have a strong taste and smell, and may be solid, liquid or powdery. The chief gum resins are ammoniac, asafetida, gamboge, myrrh, and scammony. All these contain gums, resin, oil, and coloring matter.

Ammoniac is used in medicine to make sedatives. Asafetida and gamboge are used in sedatives and in coloring fluids. Myrrh is used in medicine as an astringent, in dentistry as a tooth powder, and in perfumery as an oil. Scammony is frequently used in medicine as a laxative.

C. L. MANTELL

Related Articles in WORLD BOOK include:

Asafetida	Gamboge	Resin
Frankincense	Myrrh	Scammony

GUM TREE is the name of several trees that produce gum. The most common is the *sapodilla*, which produces a gum called chicle. This large forest tree grows in the tropics of both hemispheres. The sapodilla must grow for about 70 years before it can be tapped. The leaves are long and broad, with pointed ends. The flowers are small and the fruits are considered good to eat.

Several North American trees are called gum trees. Among them are the sweet gum, tupelo, and black tupelo. Some Australian eucalyptus trees are also known as gum trees.

Scientific Classification. The gum tree belongs to the family *Sapotaceae*. It is genus *Manilkara*, species *sapodilla*.

HAROLD NORMAN MOLDENKE

Related Articles in WORLD BOOK include:

Black Tupelo	Gum	Sweet Gum
Chicle	Sapodilla	Tupelo Tree

GUMBO. See **OKRA**.

GUMWOOD is the common name often applied to various types of trees that yield a gum. See **GUM TREE** and its list of Related Articles.

GUN is the name generally given to all firearms. But the armed forces use the term only for *artillery*, *cannon*, or *pieces*, mounted on wheels or fixed on a foundation or the deck of a warship. The rookie soldier who calls his rifle a gun may be corrected by his platoon leader.

Artillery soldiers classify cannon into three types. The *artillery rifle* has a long barrel with a 75-millimeter to 240-millimeter *bore*, or diameter. The *howitzer* has a shorter barrel. The third type, the *mortar*, has a short, stubby barrel. The artillery rifle has a longer range than either the howitzer or the mortar. Some modern artillery rifles can hurl shells 30 miles. The German Army in World War I fired a rifle that had a range of 76 miles, but it was not an accurate weapon.

Guns are usually named for the size of their bore. For example, a gun with a bore diameter of 75 millimeters is called a *75-millimeter gun*.

Shells shot from guns have a fairly flat *trajectory*, or curve, as well as a very high *velocity*, or speed. Their accuracy is caused partly by *rifling*, or spiral grooves, in the gun barrel. The spiral grooves spin the shell. Without spin, the shell would flop through the air end over end.

Historians credit the Chinese with inventing gunpowder, probably about the early 1200's. The gun was first used about 1250.

MELVIN M. JOHNSON, JR.

Related Articles. For information on various firearms such as pistols, rifles, and shotguns, see the related articles listed at the end of the **FIREARM** article. Other related articles in **WORLD BOOK** include:

Ammunition	Fire Control	Warship (picture,
Artillery	Howitzer	Development of
Bazooka	Lahore (picture)	Warship Weapons)
Cannon	Mortar	

GUNBOAT was a small warship built especially for service in rivers and coastal waters. It is obsolete among modern warship categories. The United States Navy commissioned its last specifically designed gunboat, U.S.S. *Erie*, in 1937. It served as the flagship of the special service squadron in Panama, and was lost during World War II. Before the war, the navy had several gunboats of its Asiatic Fleet on the Yangtze River in China. The Japanese sank one of these, U.S.S. *Panay*, in 1937.

Thomas Jefferson, who opposed a large navy, established a fleet of small wooden gunboats in 1804 to protect the coasts of the United States. These boats carried only one gun. They saw service in the Mediterranean Sea during the Barbary Wars and off the Atlantic Coast of the United States during the War of 1812. During the

Civil War, gunboats were used on the Mississippi River. The first metal gunboat was made of iron. The British Navy built it in 1867.

T. C. GILLMER

GUNCOTTON is an explosive. It is obtained when cotton or purified wood cellulose is soaked in a mixture of sulfuric and nitric acids. In 1846, C. F. Schönbein, a German chemist of Switzerland, discovered the process for making guncotton. After the cotton mass is soaked in the acid mixture, it is drained and washed. Then, it is boiled in water to remove all the acid and impurities. The purified cotton is ground to a pulp and drained. It is pressed into small slabs, or blocks, while still damp. It may also be dried in air, either after boiling, or after it has been made into blocks.

Guncotton that is to be used in the manufacture of plastics and some explosives may be boiled again after grinding. A centrifugal wringer removes some of the water from the boiled cotton. The rest of the water is removed, or *displaced*, with ethyl alcohol.

When ignited, dried guncotton burns very rapidly. A blow from a hammer will cause dried guncotton to explode. Wet guncotton is much safer to handle than dry. It will not burn, and can be kept in storage indefinitely. Wet guncotton will not explode unless another explosive sets it off. Ordinary guncotton burns too fast to be used in firearms. When it is *colloided*, or gelatinized, in nitroglycerin or other solvents, its burning rate can be controlled. Colloided guncotton is a major ingredient of smokeless powder.

Chemically, guncotton is a type of *cellulose nitrate*. Nitrated celluloses which have less nitration than guncotton are usually called *collodion cotton*, and are widely used in lacquers and plastics.

JULIUS ROTH

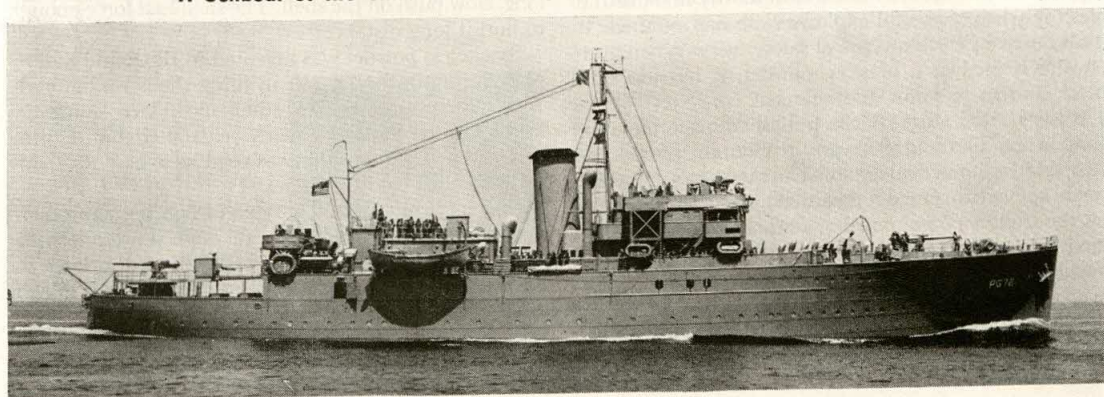
See also **BLASTING**; **PLASTICS**.

GUNNISON, JOHN W. See **COLORADO** (Famous Coloradans).

GUNNY is a strong, coarse jute cloth used to make burlap bags or sacks. It is also used for backs of floor coverings, for furniture covering, or wherever low-priced bagging or wrapping is needed. The word *gunny* comes from the Indian word *gania*, which means *hemp* (see **HEMP**). In the textile industry, gunny refers to an inexpensive burlap that is not of the best quality. Gunny is sometimes called *sacking*. Each year, the United States imports over 200,000 tons of jute fabric to be made into gunny products. See also **BURLAP**; **JUTE**. ERNEST R. KASWELL

A Gunboat of the United States Navy Usually Carried Four-Inch Deck Guns.

U.S. Navy



GUNPOWDER

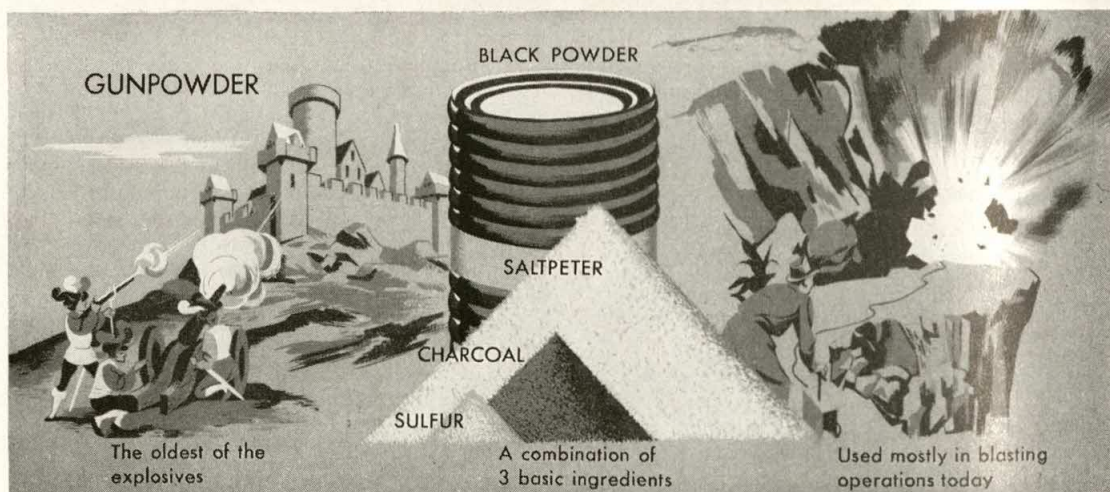
GUNPOWDER is the oldest of all explosives. It was used by the ancient Chinese, Arabs, and people of India. But exact directions for making gunpowder were not known to the Western world until 1242, when Friar Roger Bacon of Oxford University, in England, published a book in which he told how to make it. Today, gunpowder is not used as much as more powerful explosives.

How Gunpowder Is Made. Modern gunpowder, usually called *black powder*, is a mixture of charcoal, sulfur, and saltpeter (potassium nitrate). Saltpeter usually makes up 75 per cent of the mixture, charcoal 15 per cent, and sulfur 10 per cent. After it is mixed, the damp material goes to a mill where it is ground between heavy rollers. It is then placed in another machine which makes it into meal. The meal is crushed in a

explode. A tightly packed charge of gunpowder either did not burn, or burned so slowly that it had no explosive effect. But if the charge were packed very loosely, the shell would lose its driving power and fall short of its mark.

A new process for making gunpowder into grains, rather than powder, was invented in the 1400's. Under this process the powder was moistened and pounded into a cake. Then it was broken into small bits by hand and run through a sieve. The pieces which came through the sieve were of different shapes and would not fit together well enough to pack tightly, so that careful packing of cannon was no longer necessary.

When long-barreled, rifled, cannon came into use, it became necessary to find a way to slow down the rapid burning of gunpowder. Its swift explosive force often burst the barrel of the gun, causing the man who fired it to be in almost as much danger as the man he was



press so that it will become very thick. Then it is broken into grains of the desired sizes. The grains are glazed to break off sharp points and to fill the pores in the grains so that the powder will not get wet or dusty. After the grains have been glazed, they are dried and joined together. Sometimes the grains are molded into prisms.

Uses of Gunpowder. For many centuries, gunpowder was used chiefly to drive the shot from guns. But it has the disadvantage of producing clouds of smoke when it explodes. Today gunpowder is used mostly in industrial blasting where powerful explosives are not required. It is also used in certain types of safety fuses. When gunpowder is used as a blasting powder, it has less saltpeter, and more sulfur and charcoal.

History. After Roger Bacon published his formula for gunpowder, Berthold Schwarz, a German monk, developed it as a practical explosive in the 1300's. Schwarz is said to have invented a firearm which exploded shells by the action of gunpowder. Gunpowder was being used in cannons as early as 1346. At that time, gunpowder was actually in powder form. It had to be loaded carefully in the cannon, so that the charge would be packed properly. If it were packed too tightly, there would not be enough space between the bits of powder for oxygen, and oxygen is necessary if gunpowder is to

attempting to shoot. A Captain Rodman of the United States Army finally developed a gunpowder which was made into grains shaped into hexagonal prisms. These prisms were large and had several rounded parallel grooves in them. When the prisms were placed end to end, these grooves fitted to make a continuous channel. The flame burned outward from these grooves and inward from the surface of the prisms. This kept up a continuous flow of gas for long periods, and caused a long, slow push on the shell. The shell had force enough to hurl it long distances.

Smokeless powder was invented in 1884, and had replaced gunpowder for use in firing shells by the early 1900's. But gunpowder was still made in large quantities in the United States for many years after that. During World War I, gunpowder was used as a base for many shells, bombs, and torpedoes.

Heavier armor and new types of fighting equipment used in World War II required more powerful explosives, but gunpowder still was used as a primer for artillery shells. Another use in artillery or naval guns is as a charge for military salutes.

H. A. LEWIS

Related Articles in WORLD BOOK include:

Ammunition
Bacon, Roger

Blasting
Explosive

Rifle
Shrapnel



Culver

James I Questions Guy Fawkes after Fawkes and others were caught trying to blow up the English Parliament.

GUNPOWDER PLOT was a plan to blow up the English Houses of Parliament on Nov. 5, 1605, when King James I was to be present. A group headed by Robert Catesby and Guy Fawkes originated the plan (see **FAWKES, GUY**). This group resented the hostile attitude of the government toward Roman Catholicism. One of the conspirators warned a friend who reported the plot. This led to the arrest and execution of most of the group. Public hostility toward Catholics increased in England.

The English hold an annual festival on November 5, when they burn Guy Fawkes in effigy. Schoolboys make large fires, set off firecrackers, and make toffee. In memory of the Gunpowder Plot a formal search of the vaults beneath the Houses of Parliament is still made before each new session.

J. SALWYN SCHAPIRO

GUNTERSVILLE DAM. See **ALABAMA** (Electric Power).

GUNTHER. See **Nibelungenlied**.

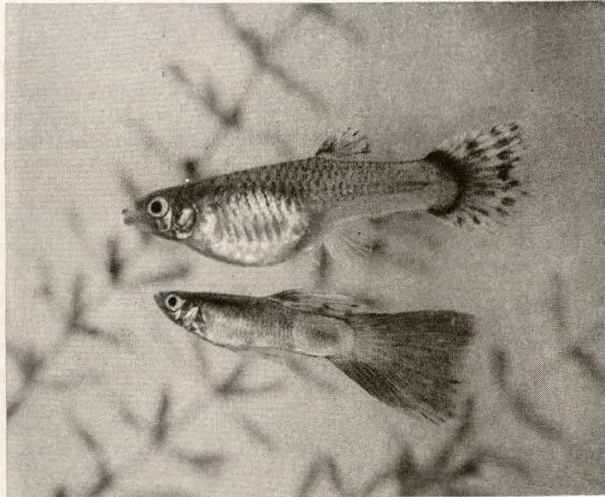
GUNTHER, JOHN (1901-), an American journalist, became famous for a series of books that drew on his observations as a foreign correspondent. His first book, *Inside Europe* (1936), appeared when most Americans first became aware that Hitler and Mussolini were leading Europe to war. It was highly successful, and during the next 20 years, Gunther used the same pattern to write *Inside Asia* (1939), *Inside Latin America* (1941), *Inside U.S.A.* (1947), *Inside Africa* (1955), and *Inside Russia Today* (1958). He also reported on his travels in eastern Europe in *Behind the Curtain* (1949). Gunther was born in Chicago. After graduating from the University of Chicago, he went abroad as a foreign correspondent as a member of the staff of the *Chicago Daily News*.

JAMES WOODRESS

GUNWALE. See **SHIP AND SHIPPING** (table, Nautical Terms).

John Gunther

Wide World



Gene Wolfshelmer

Guppies are sometimes called *rainbow fish* or *peacock fish* because of the male's bright colors. The female usually is gray.

GUPPY is a tropical fish that is popularly kept in home aquariums. Its native home is in warm fresh waters of northern South America, Trinidad, and neighboring regions. However, it has been introduced into many tropical countries throughout the world. In these places it is often used to control mosquitoes, because it eats mosquito larvae. But it is best known as an aquarium fish.

The guppy is a tiny fish. Rarely do males grow more than $\frac{3}{4}$ of an inch long. Females grow about twice that length. The male makes up for its smallness with brilliant coloring. It is spotted and streaked in rainbow hues, with variations so great that it is almost impossible to find two males exactly alike. The male pays ardent court to the female, and shows off its beauty and grace by "dancing" around the female almost constantly.

The female is a slow-moving, grayish-green fish. It bears living young that are able to swim and feed at birth. Eggs that form in the female's body are fertilized by the male. The male has a specially formed anal fin, called the *gonopodium*, in which the fertilizing material is carried. About 50 young guppies are born every four to six weeks. Once the female has produced a brood, it may be separated from the male but continue to give birth to young. This is possible because the female guppy can store the fertilizing element in her body for several months. Guppies live about three years.

Scientific Classification. The guppy belongs to the family *Poeciliidae*. It is genus *Lebistes*, species *reticulatus*.

CARL L. HUBBS

GUPTA, GOOP tuh, DYNASTY ruled in India from about A.D. 320 to the end of the 400's. Chandragupta I founded the dynasty in the Ganges region, and his successors brought most of India under Gupta control. The Gupta period was the golden age of India. Painting, sculpture, and architecture flourished. Kalidasa, the great classical writer of India, lived during this time. Mahayana Buddhism dominated religious life. Indian culture spread to central Asia, China, Indochina, and Indonesia.

H. F. SCHURMANN

GURKHA. See **NEPAL** (The People; Work of the People).

GURNARD

GURNARD is the name of some marine fishes living in all warm seas. The gurnard has a large, angular head, tapering body, and large pectoral fins. The lower fin rays move separately like fingers. The *flying gurnard* is an unusual-looking fish with immense pectoral fins that reach almost to the tail. It can "fly," or glide, through the air for distances of several yards.

Scientific Classification. Gurnards belong to the family *Triglidae*. The flying gurnard is genus *Dactylopterus*, species *volitans*.
LEONARD P. SCHULTZ

GUSHER. See PETROLEUM (Bringing Oil to the Surface).

GUSTAVUS is the name of six kings of Sweden. The first four were of the House of Vasa, and the fifth and sixth, members of the Bernadotte family.

Gustavus I (1496-1560) was the son of a nobleman, Erik Johansson. At 18, Gustavus fought for Sweden in its struggle for independence from Denmark. After being held as a hostage, he escaped to Sweden, raised a peasant army, and ousted the Danes. In 1523, he was elected king of Sweden. Gustavus gave his people good

Pomerania, its last German possession, and in 1809 Russia took Finland. These misfortunes caused a revolution and Gustavus was deposed in favor of his uncle, Charles XIII. He died in poverty in Switzerland.

Gustavus, or Gustaf, V (1858-1950), a member of the Bernadotte family, became king in 1907 on the death of Oscar II (see BERNADOTTE, JEAN B. J.). Gustavus was trained in the army and at the University of Uppsala. During his reign, many reforms were passed by Social Democratic (Socialist) governments. He favored a system of close cooperation among Scandinavian countries. He was responsible for Swedish neutrality during World Wars I and II.

Gustavus, or Gustaf, VI (1882-) became King of Sweden in 1950. The son of King Gustavus V, he was educated at the universities of Uppsala and Oslo. He served in the Swedish Army with the rank of general. His archaeological findings won him international honors. Gustavus visited the United States in 1926 and 1927, and in 1938 for the 300th anniversary of the founding of New Sweden, Del. He was born in Stockholm.
RAYMOND E. LINDGREN

GUSTAVUS ADOLPHUS COLLEGE is a coeducational liberal arts school at St. Peter, Minn. Courses lead to bachelor's degrees. Founded in 1862 by Erik Norelius, Gustavus Adolphus College is directed by the Augustana Lutheran Church. For enrollment see UNIVERSITIES AND COLLEGES (table).

GUTENBERG, JOHANNES (1395?-1468?), invented the type mold, which made printing from movable metallic type practical for the first time. The invention assured an adequate supply of the letters which were uniformly cast on equal metal bodies. Gutenberg and his associates used his invention in producing splendid books at Mainz, Germany, during the mid-1400's.



Culver

Gustavus Adolphus



Text & Bilder, Stockholm

Gustaf VI



Johannes Gutenberg, left, invented the Gutenberg press. The painting, below, shows Gutenberg and a friend looking at a proof sheet.

United Press Int.; Ewing Galloway



government, and established the Lutheran faith as Sweden's state religion.

Gustavus II (1594-1632), better known as GUSTAVUS ADOLPHUS, ruled Sweden from 1611 to 1632. He came to the throne when Sweden was at war with Denmark, Poland, and Russia. After winning these wars, he led an army into Germany in 1630 to save the Protestants from Roman Catholic domination. In 1631, he defeated the Catholics at the battle of Breitenfeld. The following year, his troops overwhelmed those of Albrecht von Wallenstein at Lützen (see LÜTZEN, BATTLES OF). But Gustavus did not see the victory, for he died on the battlefield. His victory saved Protestantism in Germany, and won German territory for Sweden. See also ARMY (Conscription); THIRTY YEARS' WAR.

Gustavus III (1746-1792) ruled from 1771 to 1792. He became king while Sweden was suffering from rival political groups and the misrule of the nobles. Gustavus forced the parliament to accept a new constitution. During his reign, Swedish trade and commerce increased. His influence, along with his own plays and poems, inspired a period of brilliant literature in Sweden. In 1792, through a conspiracy of nobles, he was shot to death at a masked ball.

Gustavus IV (1778-1837), the son of Gustavus III, ruled from 1792 to 1809. During his reign, Sweden lost

Gutenberg was born in Mainz, a member of the aristocratic Gensfleisch family. He used his mother's name. He may have learned the necessary skills in metalwork from an uncle who was master of the mint. At that time, Mainz was a center for many goldsmiths and jewelers. As an aristocrat, Gutenberg did not have to serve a regular apprenticeship.

Because of his family's involvement in local political squabbles, Gutenberg spent a number of years in exile at Strasbourg. He carried on experiments there to develop his revolutionary idea of the type mold. The mold was one of the earliest precision instruments. The types it produced could be ranged in even lines of composition. Then they could be locked firmly together under the pressure of *quoins*, or wedges, so as to make up a *form*, or unit. Thus, a number of pages containing many thousands of types could easily be put on and taken off the press. After printing, the same types could be separated, and used again and again to set up other pages. Gutenberg adapted the ink for his press from materials known to early Flemish painters.

Long before Gutenberg's time, the Chinese and Koreans had been printing text and pictures cut on woodblocks. They had even invented movable types of porcelain and metal. But their language was so complicated, and it required so many different types, that they could not make practical use of the method. The idea was lost until Gutenberg applied it successfully to the alphabet. Others were struggling to solve the problem. At least one Dutch printer was well along the road to successful typography. But Gutenberg and his associates, Johannes Fust and Peter Schöffer, perfected it. Their magnificent 42-line Bible, which is commonly known as the *Mazarin Bible*, shows that these three pioneer printers had mastered every technical detail (see BIBLE [picture, Two Famous Bibles]). RAY NASH

See also BOOK (Printed Books); BOOK COLLECTING.

GUTHRIE, ALFRED BERTRAM, JR. (1901-), an American novelist, wrote of pioneering in the Far West. *The Big Sky* (1947), his first serious novel, is about the fur trade during the migration to Oregon from 1830 to 1843. *The Way West* (1949), which won a Pulitzer prize, describes hardships on a wagon train. *These Thousand Hills* (1956) tells of cattle trailing from Boise City to Fort Benton, Mont., in the 1880's. Born in Bedford, Ind., Guthrie grew up in Montana, and then worked as a journalist until 1947. HARRY R. WARFEL

GUTHRIE, JAMES. See KENTUCKY (Famous Kentuckians).

GUTHRIE, SAMUEL. See CHLOROFORM.

GUTHRUM. See ALFRED THE GREAT.

GUTTA-PERCHA is a milky juice obtained chiefly from the *Palaquium gutta* trees of the Malay Peninsula. Gutta-percha is used as insulation for electric wire and submarine cables. It is also used to make containers for acids, surgical bandages, castings, and temporary tooth fillings. It once was used in making golf balls, but has been replaced by more resilient materials.

To obtain gutta-percha, Malays cut the bark of the tree and catch the juice in cups as it flows slowly out. The process is similar to that used to obtain crude rubber (see RUBBER [The Rubber Tree]). The juice is then boiled in open kettles. If it is very thick, water is added to it before boiling. The boiled juice cools, hardens, and is cut into blocks which range from white to a dark gray



Embassy of the Federation of Malaya

A Malay Worker Holds a Piece of Gutta-Percha Gum, obtained by boiling the milky juice of the gutta-percha tree.

in color. It is so soft that it can be dented, and it does not break easily. When it is heated again, gutta-percha, like rubber, can be drawn out to great lengths without breaking. But it will not return to its former shape, as rubber does. Gutta-percha without stabilizers cannot be exposed to light or air for long periods or it will oxidize and become brittle. C. L. MANTELL

GUY FAWKES DAY. See FAWKES, GUY.

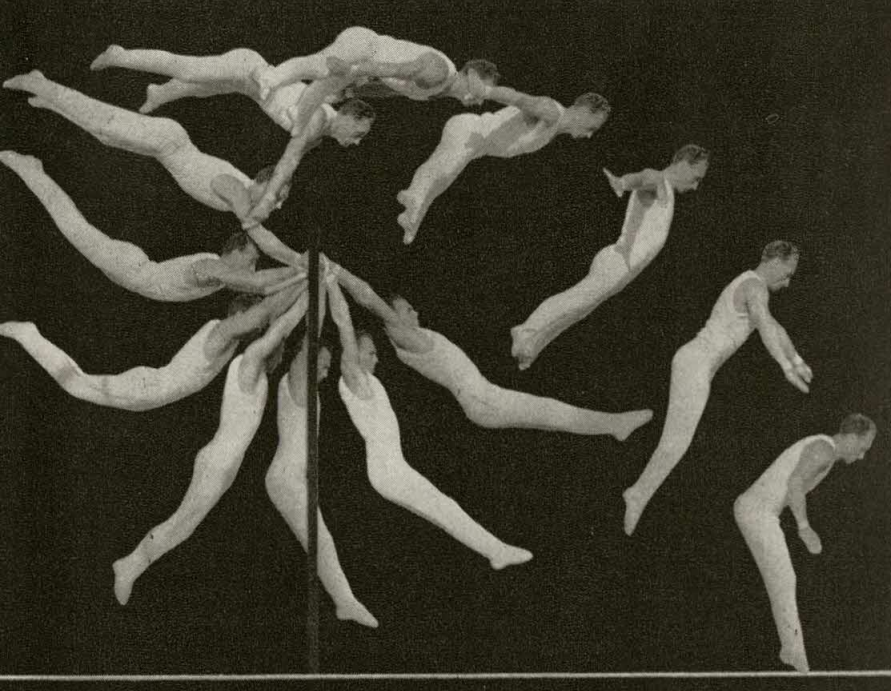
GUY OF WARWICK, WAHR ick, was the legendary hero of an English romance. He is said to have rescued England from Danish rule by killing the giant Colbrand. The story says that Guy was in love with Felice, daughter of the Earl of Warwick. But she at first refused to marry him. After he had rescued a German princess, killed a dragon, and defeated the Saracens, Sir Guy married Felice. But he soon left on a crusade, and when he returned he lived as a hermit. Finally, he sent his wife a ring that she recognized, and they were reunited. Historians believe that the original Sir Guy may have lived during the 900's. KNOX WILSON

GWEDUC. See GOEDUCK.

GWINNETT, BUTTON (1735?-1777), a Georgia signer of the Declaration of Independence, served in the Georgia Assembly in 1769 and in the Continental Congress in 1776 and 1777. For a brief period, he was acting governor of Georgia in 1777. Gwinnett was killed in a duel with General Lachlan McIntosh. Their duel resulted from their rivalry for the post of brigadier general of troops raised in Georgia.

Gwinnett was born in Gloucestershire, England. He settled first in Charleston, S.C., and then moved to Savannah, Ga., where he became a merchant. He owned a plantation on St. Catherine's Island. RICHARD B. MORRIS

GWYN, or GWYNNE, "NELL," ELEANOR (1650-1687), was one of England's first actresses. John Dryden wrote many plays for her. Before going on the stage in 1665, she sold oranges in the Theatre Royal. Her talent, beauty, and wit made her a favorite of King Charles II. Just before he died, he wrote "Let not poor Nellie starve." HELEN E. MARSHALL



Fernand Rausser, *Parade Magazine*

Gymnastic Exercises include many daring and difficult maneuvers performed on various kinds of apparatus. The gymnast, above, executes a graceful flying dismount from the horizontal bar. Such exercises develop the arm and shoulder muscles. The young girl, right, bounces high on the trampoline, a strong piece of canvas stretched between springs. At the top of the bounce, she may spin through somersaults and other movements that help develop muscle coordination.



Chicago Park District

GYMNASIUM, *jim NAY zih um*, is a special room or building for instruction and practice in physical training. Apparatus found in gymnasiums includes horizontal bars, parallel bars, flying rings, vaulting horses, climbing ropes, poles, ladders, mattresses, Indian clubs, dumbbells, punching bags, rowing machines, and pulley weights.

Small gymnasiums found in most schools usually cover only one floor. They include dressing rooms, toilets, and showers. They usually have an office for a physical education teacher. Many school gymnasiums also have stages used for school assemblies and community meetings. School gymnasiums usually serve as a center for musical, social, and athletic activities, in addition to basic instruction in physical education.

A large gymnasium may cost millions of dollars. It may have a large basketball court that seats 10,000 to 20,000 spectators. It may also have an indoor running track, a swimming pool, and many separate rooms and areas for dancing, boxing, wrestling, and other sports. A large gymnasium usually has equipment rooms, a first-aid room, and other facilities.

The word *gymnasium* comes from a Greek word meaning to exercise naked. In ancient Greece, the word was used to mean public places set aside for athletic sports. Greek boys and young men wore no clothes when taking part in games, in order to have freedom of bodily movement. The first gymnasium on an American campus was opened in 1860 at Amherst College.

In some European countries, *gymnasium* is the name for a type of secondary school.

T. K. CURETON, JR.

See also GYMNASTICS; PHYSICAL EDUCATION; PHYSICAL FITNESS.

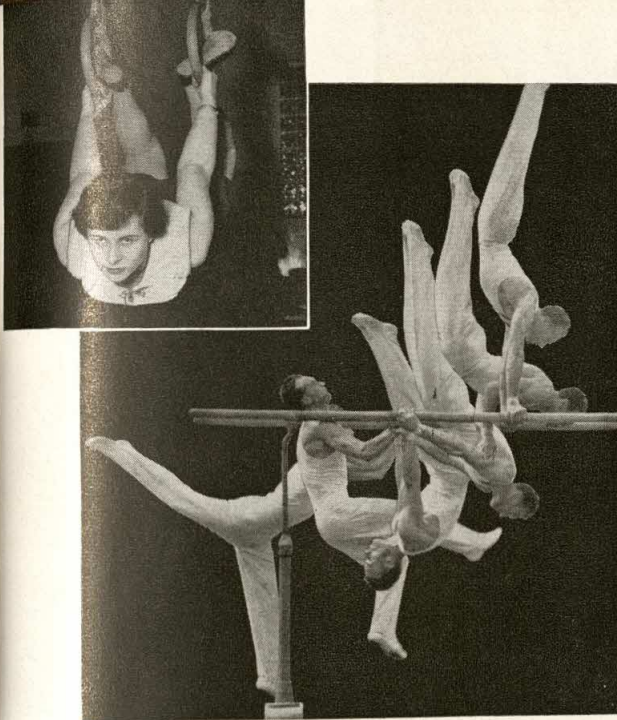
GYMNASTICS, *jim NAS ticks*, are exercises, usually done in a gymnasium, to improve physical fitness and health. In the United States, several gymnastic systems are used, including Danish, Swedish, German, and American.

Danish Gymnastics consists of free and continuous group drill. The drills usually have a definite sequence, or order, and may be done for a half hour or more. During this time, all the members in the drill assume exactly the same positions. The drill has pauses, but their purpose is to allow the members to assume postures and positions that indicate fitness. The Danish system stresses flexibility, balance, agility, and endurance.

Swedish Gymnastics emphasizes good posture and fixed positions that are assumed on command from a group leader. The exercises are easily adapted to develop weak muscles and to correct posture. The system is noted for its use of such equipment as balance beams, stall bars and benches, bucks, and long horses.

German Gymnastics uses a variety of equipment, including parallel bars, ropes, rings, bucks, and horizontal bars. The system also uses vaulting, climbing, running, and walking as ways to increase health and improve physical fitness. The system emphasizes physical development for both children and adults.

American Gymnastics combines many features of the Danish, Swedish, and German systems. The Danish exercises are usually used with groups to develop fitness. The American system uses Swedish gymnastics to correct posture and develop weak muscles. The equipment used in the German system is used in many schools, YMCA's, and colleges for basic instruction in physi-

Chicago Tribune; Fernand Rausser, *Parade Magazine*

Gymnastic Apparatus includes the flying rings, upper left, and parallel bars, above. The series of pictures shows the grace and skill needed by gymnasts in performing an exercise.

cal education. The American system has added many of its own features, such as tumbling and trampoline work, indoor obstacle courses, indoor steeplechases, and training on an indoor track. The American system has also developed fitness tests for balance, flexibility, strength, and endurance.

T. K. CURETON, JR.

See also CALISTHENICS; EXERCISE; PHYSICAL EDUCATION; PHYSICAL FITNESS.

GYMNOSPERM, *JIM no spurm*, is the name of one of the two large classes of seed plants. The plants in the gymnosperm class have naked, or uncovered, seeds. The term *gymnosperm* comes from two Greek words meaning *naked* and *seed*. The other class, called the *angiosperms*, consists of plants whose seeds possess a protective *ovary*, or seed case.

Gymnosperms are woody perennials which are among

the largest and oldest living plants. The class contains about 500 kinds of plants. About 350 are cone-bearing trees such as the pines, firs, spruces, and balsams. These coniferous trees make up the largest order of gymnosperms. The tropical and subtropical cycads, also gymnosperms, are the most primitive living seed plants.

Many of the gymnosperms are evergreen with a wide variety in the structure of the leaves. They do not bear brightly colored flowers, and the wind usually carries out their pollination. The naked, or exposed, seeds are borne between the scales of the female cones and drop when they become ripe. Gymnosperms provide the source of many valuable products such as tar, turpentine, rosin, and timber.

Scientific Classification. Gymnosperms are in the subkingdom *Embryophyta*, phylum *Tracheophyta*. They make up the class *Gymnospermae*.

WILLIAM C. BEAVER

See also ANGIOSPERM; CONE-BEARING TREES; SEED.

GYPSUM, *JIP sum* (chemical formula, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), is a white or yellowish-white mineral used to make plaster of Paris. The large beds of gypsum are supposed to have been formed when the water evaporated from solutions of the mineral. Gypsum is so soft that it can be scratched with the finger nail. Sometimes it comes in transparent crystals called *selenite*.

The chemical formula of gypsum shows that it is a *hydrate* of calcium sulfate. A hydrate contains water in addition to its other substances. When the gypsum is heated, it loses three fourths of its water. This process, called *calcination*, changes it to the fine white powder called *plaster of Paris*. The plaster hardens quickly after it is mixed with water and exposed to the air. Plaster of Paris is used to make casts of all sorts.

Heating the gypsum at higher temperatures will drive off all the water. Calcined gypsum in this form is used in the building industry for base-coat plaster, Keene's cement, plasterboard, lath, and wallboard. It is also used as a filler in such products as candy and paint.

Ground gypsum, or *land plaster*, is sometimes used as a fertilizer for soils that need lime. It is not used much today, because ground limestone and prepared fertilizers have largely taken its place. An important use of raw gypsum is to keep portland cement from hardening too quickly. Raw gypsum is also used to make paint, terra alba, filters, insulation, and wall plaster.

Most of the "hard" water from springs and wells contains gypsum in solution. When the water is boiled, some of the gypsum forms a white crust on the sides and bottom of the vessel.

The United States produces more gypsum than any other country. It also uses most of the output of Canada, the third largest producer. Gypsum has been produced in the United States since 1850. The leading states are Michigan, New York, Texas, and Iowa. Oklahoma, Nevada, Kansas, California, and other western states also supply important amounts. France is normally the leading source outside the United States. The name *plaster of Paris* comes from the important gypsum deposits in the Paris Basin. Britain, Germany, Spain, Italy, and Russia are important producers. The largest deposit in North America, near Halifax, Nova Scotia, has been worked since 1955.

A. PABST

See also ALABASTER; HARDNESS; PLASTER OF PARIS.

HOW A GYMNASPERM GROWS

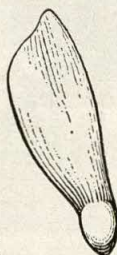


Pine Cone, showing the arrangement of the scales



Scale from a Cone showing how seeds grow upon the scales

The Winged Seed of a Gymnosperm





Historical Pictures Service

A Band of Bohemian Gypsies on the March is shown in this sketch of an ancient tapestry from a French château.

GYPSY, or **GIPSY**, *JIP sih*, is a member of a group of people whose ancestors probably came from India in the A.D. 1300's. They wandered through Iran to Armenia, Syria, Egypt, and North Africa. In the 1500's, gypsies reached Europe. They moved into Romania, Hungary, Spain, France, Russia, and England. Small numbers of gypsies crossed from Europe to North America. From time to time, a few of them have settled down and established homes, but most of them continue their stateless, nomadic existence, living according to their own laws.

Gypsies are called by various names, such as *Tziganes*, *Romanies*, *Maniches*, and *Children of Little Egypt*. Early gypsies had wavy dark hair, large black or brown eyes, and dark skin. Their heads were usually rounded, and they averaged about five feet four inches in height. Most wandering gypsies have kept the same characteristics as the early tribes. Settled gypsies have come to look more and more like the people among whom they settled.

Gypsies jealously guard their customs and traditions. The Romanies speak a language based on the ancient Sanskrit or Prakrit. Other groups speak the language of the country in which they live.

Gypsy customs differ with different tribes. Groups in most Catholic countries observe feast days, ceremonies, pilgrimages, and rites according to the Roman Catholic Church. In England, the religion of the gypsies is usually that of the Church of England.

In Spain, about 3,000 gypsies live in the dry, airy caves in the Sierra Nevada foothills near Granada. Their cave homes range from single rooms to large ones of about 20 rooms. Their stores, schools, and churches are also established in caves. Some of these gypsies have become prosperous through dancing and singing for tourist visitors. They are experts in the Spanish dance called the *flamenco* (see **FLAMENCO**).

Gypsy men from earliest times have been skilled musicians and metalworkers. They have also since ancient times been blacksmiths and horse traders. In America, they once followed county fairs and carnivals. Now that horses are no longer much needed, many gypsies have become traders in used cars.

Gypsies are associated with a gay life, wandering as they will, gathering around campfires to sing songs and to dance. Gypsy clothing often includes bright braid and embroidery, gold bangles and jewelry. Gypsies are also associated with bold pranks and stealing. In some instances, this concept of gypsies is still true, but gypsy life is not always gay, nor are all gypsies dishonest. During World War II, thousands of Hungarian, Czech, Romanian, and Polish gypsies were murdered in Nazi concentration camps.

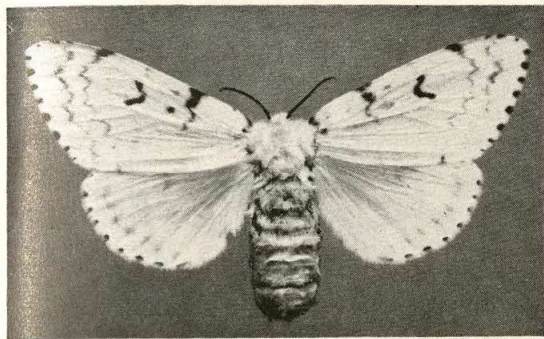
WILTON MARION KROGMAN

See also **DULCIMER** (picture).

Caravans of Gypsies once wandered through many European countries and the United States. But today the laws in many areas forbid their wandering from place to place.



Wide World



USDA

The Female Gypsy Moth is the enemy of all shade and fruit trees. It is white or buff-colored and has a wingspread of two or more inches. It has well-developed wings, but rarely flies.

GYPSY MOTH is a member of the tussock moth family that is destructive to trees. Gypsy moth caterpillars eat the foliage of nearly all forest, shade, and fruit trees. In spite of attempts to limit them by quarantine, they have spread over much of New England and into New York, New Jersey, and Pennsylvania.

The caterpillars hatch in spring and reach their full size of 3 inches by midsummer. They are brown with tufts of hairs. Five pairs of blue spots and six pairs of red spots are located on their backs. The insects emerge as adult moths after 7 to 18 days in loose cocoons. The male moths, brownish gray with irregular dark marks, are strong fliers. The females are much larger and cream white with contrasting dark marks. The females fly little, if at all. They lay 400 to 500 eggs in masses on their cocoons.

In 1869, the gypsy moth was brought into Massachusetts from Europe for scientific experiments. The *Calosoma* beetle and other parasitic insects that feed on the moth in Europe have been introduced in the United States. These insects, and a wilt disease, control the moth in some areas.

To destroy gypsy moths, collect the egg masses and burn them or treat them with creosote. Collect caterpillars by banding trees with coarse cloth. In the spring, trees can be sprayed with lead arsenate or DDT. Use $\frac{3}{4}$ to 1 pound of DDT per acre or 5 to 10 pounds of lead arsenate in 100 gallons of water. Trees may also be protected by banding them with a sticky substance called *tanglefoot*.

Scientific Classification. The gypsy moth belongs to the family *Lymantriidae*. It is genus *Lymantria*, species *dispar*.

ALEXANDER B. KLOTS

See also **TUSOCK MOTH**.

GYRFALCON. See **FALCON** AND **FALCONRY**.

GYRO, DIRECTIONAL. See **AIRCRAFT INSTRUMENTS**.

GYRO-HORIZON. See **AIRCRAFT INSTRUMENTS**.

GYROCOMPASS is a gyroscopic device used on ships to tell direction. The gyrocompass is superior to the magnetic compass because it is not affected by magnetic forces or by the rolling and pitching of a ship. The axle of the gyroscope in the gyrocompass is horizontal and always points to *true*, or geographic, north, rather than magnetic north (see **COMPASS**). This makes it possible for the navigator always to know exactly in what direction his vessel is headed. It also enables him to know his relation to other craft or objects at sea.

When scientists began trying to make a gyrocompass in the early 1900's, they discovered that a gyroscope would keep pointing north. But they also saw that it slowly turned over as the earth rotated under it. To correct this turning, they fastened two pairs of cylinders, each pair connected by a small tube, to the inner frame, or *inner gimbal*, of the gyroscope. They filled the cylinders with mercury that was free to flow back and forth through the tubes. The weight of the mercury pulled by the earth's gravity kept the gyroscope from turning over as the earth rotated.

The gyrocompass used on most ships has a rotor 11 inches across that weighs 55 pounds. The rotor is driven by an electric motor at a speed of about 6,000 rpm. This motor can keep the gyroscope turning for months without being shut down. The gyrocompass is usually mounted in a special compartment below decks. It is connected with instruments which repeat the compass' information on the bridge and in radar sets. On warships it also is connected with guns and fire-control directors used for aiming guns. Inertial guidance systems in guided missiles may use gyrocompasses.

Hermann Anschütz-Kampfe patented the gyrocompass in Germany in 1906. Elmer A. Sperry developed his gyrocompass in the United States and demonstrated it successfully in 1911 on the United States battleship *Delaware*.

PAUL W. BIGELOW

See also **GYROSCOPE**; **GYROSYN COMPASS**; **SPERRY**, **ELMER A.**

GYROPILOT, or **AUTOMATIC PILOT**, is a device which automatically steers ships or aircraft. The device contains gyroscopes which steer the ship or aircraft closer to a course than a human pilot can. The gyropilot makes possible more accurate navigation and more economical operation.

An automatic pilot for airplanes contains two gyroscopes. The vertical gyro controls the ailerons and elevators of the airplane. The gyrosyn compass controls the rudder. Corrective signals to the aircraft controls are produced when the aircraft moves from its proper course and *attitude*, or position. These signals are voltage displacements which are amplified and sent to *servo units*, which have small electric motors that move the aircraft's controls.

Lawrence Sperry, son of Elmer A. Sperry, in 1912 invented and flight tested an automatic gyroscopic stabilizing device for airplanes using four gyroscopes. In 1932, the Sperry Gyroscope Company (now Sperry-Rand) developed its first gyropilot flight control for modern planes. This automatic pilot was installed on Wiley Post's airplane, the *Winnie Mae*. The automatic pilot helped Post make the first solo flight around the world in 1933 (see **POST**, **WILEY**). He made his flight in a little more than 7 days, 18 hours.

The gyropilot for ships controls the rudder by corrective signals from a gyrocompass. The first automatic pilot for ships was used on the Standard Oil tanker *J. A. Moffett* in the early 1920's. The automatic pilot aboard ships is often called *Iron Mike*, or the *Iron Quartermaster*.

PAUL W. BIGELOW

See also **AIRCRAFT INSTRUMENTS**; **GYROSCOPE**; **GYROSYN COMPASS**; **NAVIGATION** (picture, **Gyropilot**); **SPERRY**, **ELMER A.**

GYROSCOPE

GYROSCOPE, *JY roh scohp*, is a mechanical device that seems to defy the force of gravity. A gyroscope, sometimes called a *gyro*, is basically a spinning wheel mounted in a movable frame. A toy gyroscope can perform amazing tricks. It can balance at an angle on the end of your finger even if you move your hand about. It can balance on the edge of a drinking glass, and if you try to push it gently down it will not fall. If you point the axle of a rapidly spinning gyroscope at the sun, the end of the axle will appear to follow the sun as it crosses the sky. This is because the gyroscope holds its original position in space while the earth turns under it.

How a Gyroscope Works

Parts of a Gyroscope. The main part of the gyroscope is the wheel, or *rotor*. An *axle* passes at right angles through the center of the rotor. The ends of the axle are mounted on bearings in a frame called an *inner gimbal*. This frame, in turn, is supported by bearings in an *outer gimbal*. And the outer gimbal is mounted on bearings in a supporting frame. By mounting the rotor within the gimbals, the axle can be pointed in any direction. However, the exact center of the rotor always remains in a fixed position within the gimbals.

Gyroscope rotors used in aircraft instruments may be smaller than 2 inches across and revolve 35,000 times a minute. On the other hand, three gyroscope rotors, each 13 feet across, were built in 1933 for the gyrostabilizers in the ocean liner *Conte Di Savoia*. Each of these rotors weighed 110 tons and whirled 800 times a minute.

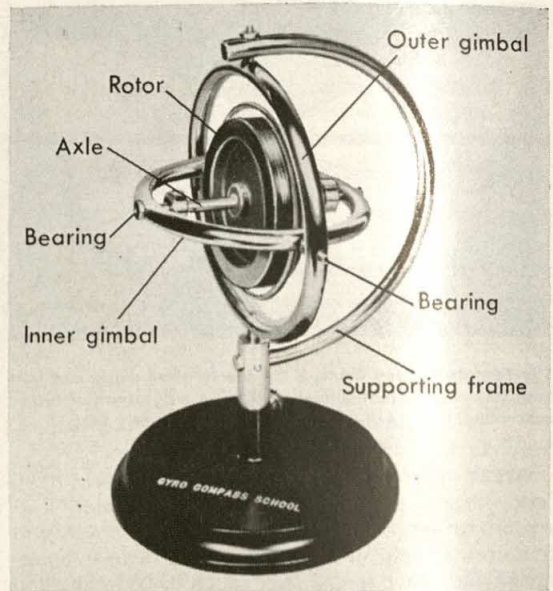
Toy gyroscopes usually are set in motion by wrapping a string around the axle and pulling the string. But most gyroscope rotors used in instruments are driven by self-contained electric motors.

The bearings on which a gyroscope rotates must be made with great accuracy, so that they will have as little friction as possible. The ball bearings must be within a tiny fraction of an inch of being perfectly round. The bearings must be assembled in windowless, air-conditioned factory rooms, because a speck of dust inside a bearing might cause a gyro to fail.

Gyroscopic Forces. When you ride on a bicycle, it is almost the same as if you were riding a gyroscope. You must control gyroscopic forces in order to ride the bicycle successfully. To keep the bicycle standing upright, you must keep the wheels spinning. If you lean slightly to one side, the bicycle will not fall over, but it will turn in that direction. The bicycle demonstrates the two basic gyroscopic forces: (1) gyroscopic inertia and (2) precession.

Gyroscopic Inertia is the ability of the spinning axle of a gyroscope *always to point in the same direction*, no matter how the support of the gyroscope moves about. It is gyroscopic inertia that keeps the bicycle upright as long as the wheels keep spinning. You also make use of gyroscopic inertia when you pass a football. You set the football spinning to send it straight to its target without wobbling.

Precession is the tendency of a gyroscope *to move at right angles* to the direction of any force applied against it. Precession makes the bicycle turn a corner when you lean to one side. You also use precession to guide a rolling hoop. When you roll the hoop, it will not fall



Sperry Gyroscope Co.

Parts of a Gyroscope. This simple gyroscope is used in school classrooms to demonstrate gyroscopic principles.

down if you push from the side against the top, it merely will turn a corner. The hoop *precesses*, or turns at right angles to the force you have applied against it.

How Gyroscopes Are Used

In Ships and Aircraft. The most important use of gyroscopes is in navigation instruments for ships and aircraft. Compasses regulated by gyroscopes make it possible for navigators always to know exactly in what direction their crafts are headed. These compasses are not affected by magnetic forces or by the rolling and pitching of the ship. Gyroscopes also have been used as gyrostabilizers to reduce the rolling of ships at sea. Many gyroscopic instruments such as the turn-and-bank indicator and the gyro-horizon help aircraft pilots know the position of their plane in the air. Automatic pilots using gyroscopic controls are used on both ships and aircraft.

In Industry and Mining. Road mappers and surveyors find gyroscopes useful in recording curves and grades. Oil-well drillers and mining engineers have used gyroscopic instruments to make sure they are drilling in the direction they want to go.

In Military Equipment. Gyroscopes help to steer torpedoes and guided missiles automatically. They are used in bombsights that direct bombs to their targets. Gyroscopes are used to help aim antiaircraft guns and the guns of warships. They are used in gunsights on jet fighter planes that automatically aim guns, rockets, and bombs. Gyroscopic devices are also important because they navigate guided missiles.

History of the Gyroscope

The first written record of a gyroscope is in Gilbert's *Annalen*, in 1818. This report described a gyroscope made in 1810 by a German, G. C. Bohnenberger. Jean Foucault, a French physicist, built a gyroscope in 1852 with which he demonstrated that the earth rotates on its axis. Foucault named the instrument a *gyroscope*,

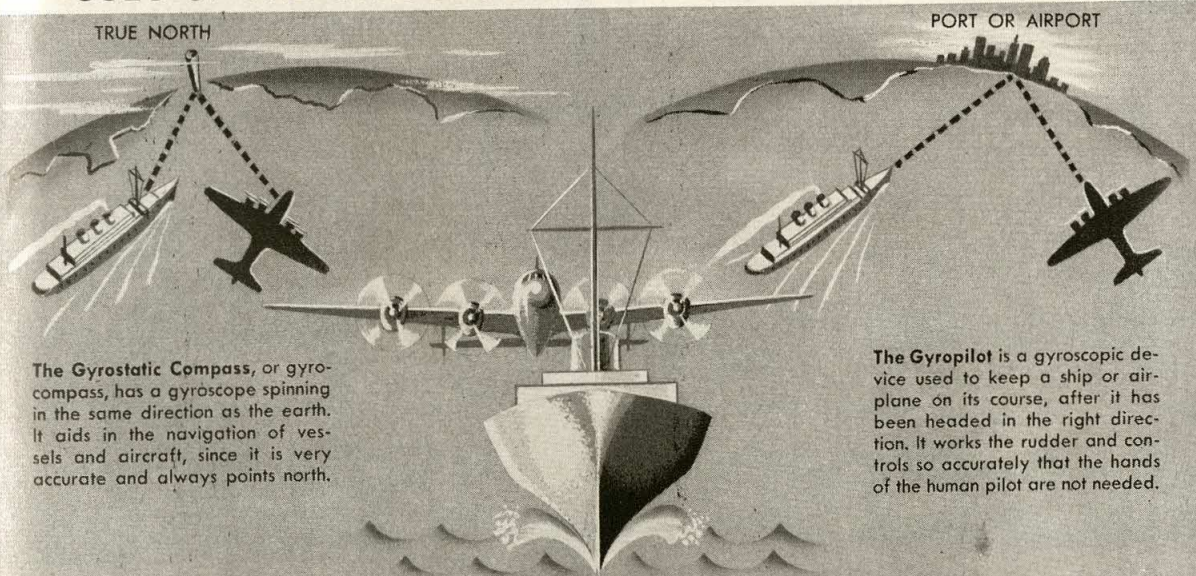
taking it from two Greek words, *gyras*, meaning *revolution*, and *skopein*, meaning to *view*. Thus gyroscope means *to view the revolution of the earth*.

The Scottish engineer Robert Whitehead first used the gyroscope in military equipment. He perfected a gyroscopically controlled torpedo in 1896.

About 1900, men began to build more ships of steel instead of wood. The magnetic compasses that had been satisfactory in wooden ships were less trustworthy in

steel hulls. A German scientist, Hermann Anschütz-Kampfe, developed a gyrocompass in 1906 to overcome this problem. By 1911, Elmer A. Sperry, an American scientist and inventor, demonstrated a successful gyrocompass on a United States warship. Early in World War I, a Sperry gyrocompass helped guide the British fleet to the Falkland Islands in record time to defeat

USES OF THE GYROSCOPE IN AVIATION AND NAVIGATION



The Gyrostatic Compass, or gyrocompass, has a gyroscope spinning in the same direction as the earth. It aids in the navigation of vessels and aircraft, since it is very accurate and always points north.

The Gyropilot is a gyroscopic device used to keep a ship or airplane on its course, after it has been headed in the right direction. It works the rudder and controls so accurately that the hands of the human pilot are not needed.

The Gyroscopic Stabilizer, or gyro-stabilizer, helps to keep aircraft and ships at sea from rolling in "bumpy air" and rough water. It is mounted in the hull, which it helps to keep level by resisting any tendency toward tilting.



The Universal Director uses gyroscopic principles to determine the aiming of artillery. It combines information secured from the range finder and other instruments, and makes accurate aiming possible.

IN OIL-WELL DRILLING

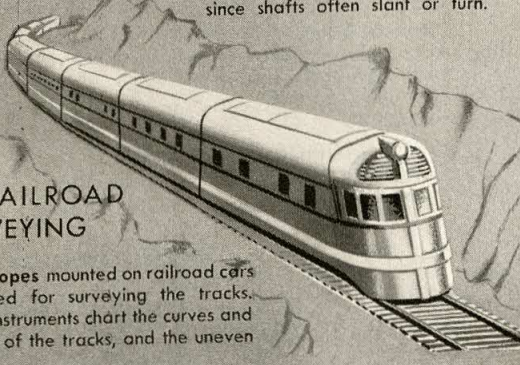


The Gyroscope makes it possible to determine and control the direction of the shaft of an oil well at great depths under the ground. This is a help in accurate drilling, since shafts often slant or turn.



Trucks used for surveying highways are sometimes equipped with gyrocompasses to aid in mapping the curves of the highways accurately.

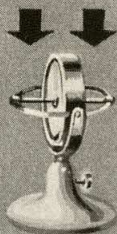
IN RAILROAD SURVEYING



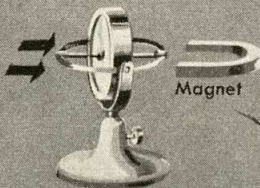
Gyroscopes mounted on railroad cars are used for surveying the tracks. These instruments chart the curves and grades of the tracks, and the uneven places.

WHY A GYROSCOPE IS USEFUL IN NAVIGATION

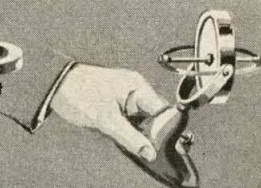
The spinning gyroscope resists the forces of gravity



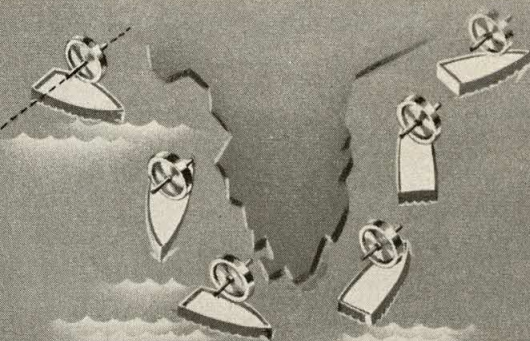
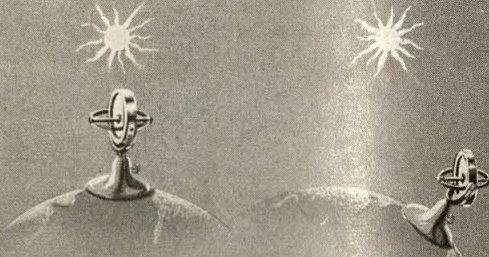
The gyroscope is not affected by magnetic force



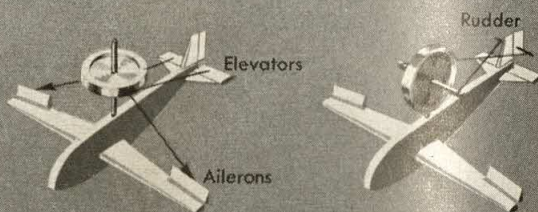
Though the base is tilted, the wheel spins in the same plane



The spinning gyroscope wheel does not change the plane in which it rotates, even though its base is tilted by the rotation of the earth.



No matter how the ship changes its position as it moves around the peninsula, the gyroscope spins in the same plane. This gives the ship a compass which is not affected by magnetism or movement.



The gyropilot uses two gyroscopes to operate the controls of the airplane. The horizontal gyroscope operates the ailerons and elevators. The vertical gyroscope controls the plane's rudder.

Prepared in cooperation with
Sperry Gyroscope Company

Vice Admiral Maximilian von Spee's German squadron.

In 1912, Sperry's son Lawrence invented an automatic pilot that used gyroscopes to stabilize an airplane's controls. In 1914, Lawrence Sperry competed in Paris with 53 other entrants and won a prize of 50,000 francs for the most stable airplane. He demonstrated his plane's stability by flying low over the judges while he took his hands off the controls and a mechanic walked out on the plane's wing. In 1918, Lawrence Sperry also developed the gyroscopically-controlled turn indicator for airplanes.

The directional gyro and the gyro-horizon were developed by the Sperry Gyroscope Company in 1928, enabling aircraft to fly safely at night and in bad weather. The Sperry Company also introduced the *gyrosyn compass* in 1946 and the *zero reader flight director* in 1948.

Scientists working on the problems of space flight expect gyroscopes to play an important part in navigating spaceships.

PAUL W. BIGELOW

Related Articles in WORLD BOOK include:

Aircraft Instruments
Ford, Hannibal Choate
Foucault, Jean B. L.
Gyrocompass

Gyropilot
Gyrostabilizer
Gyrosyn Compass
Sperry, Elmer A.

GYROSCOPIC COMPASS. See GYROCOMPASS; GYROSCOPE; GYROSYN COMPASS; SPERRY, ELMER AMBROSE.

GYROSTABILIZER, *yx roh STAY buh LIZE er*, is a large gyroscope that reduces the rolling of a ship at sea and makes travel more comfortable. The gyrostabilizer is

mounted on pedestals bolted to the ship's framework. A self-contained electric motor drives the rotor. Gyroscopic inertia causes the gyrostabilizer to resist the rolling effect of waves beating against the ship. A gyrostabilizer usually weighs several thousand pounds, about one and one-half per cent of the entire weight of a ship. A number of ships and yachts built between World War I and World War II used gyrostabilizers. Their use fell off rapidly after World War II, because of the high cost of making and installing them. PAUL W. BIGELOW

See also GYROSCOPE.

GYROSYN COMPASS is a magnetic compass stabilized with a gyroscope. It is used in aircraft. Basically, it is a gyroscope that spins on a horizontal axle which automatically points toward the magnetic North Pole. Unlike an ordinary magnetic compass, it is quick to adjust to changed courses by the aircraft. The Gyrosyn Compass is controlled by a magnetic element, or *flux valve*, which is mounted in the wing tip or some other remote location on the plane. Any change in relation between the aircraft and the earth's magnetic field results in a voltage signal in the flux valve. This signal is amplified electronically and applied to the gyroscope to keep it lined up on magnetic north. The Gyrosyn Compass is driven electrically and can operate repeaters wherever needed in the aircraft. Gyrosyn Compass is a trade name. It was developed by the Sperry Gyroscope Company (now Sperry-Rand) and came into use following World War II.

PAUL W. BIGELOW

See AIRCRAFT INSTRUMENTS; GYROSCOPE.